Comments on Reregistration Eligibility Science Chapter For Atrazine: Environmental Fate and Effects Chapter

Principal Authors
Alan Hosmer, Tom Parshley, and Steven Wall

Syngenta Crop Protection, Inc.
P.O. Box 18300
Greensboro, NC 27419

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Executive Summary

Syngenta Crop Protection, Inc. has reviewed the EPA's Reregistration Eligibility Science Chapter for Atrazine, Environmental Fate and Effects Chapter, (Draft RED). As requested in the EPA cover letter dated December 8, 2000 (received by Syngenta December 11, 2000), this document contains comments on the preliminary documents.

The EPA has performed a preliminary, lower tier assessment (Tier I/Tier II) of atrazine. However, as described by the Ecological Committee on FIFRA Risk Assessment Methods (1), considerable refinement and increased accuracy of risk assessments are possible when additional data are available. No other pesticide is supported by the wealth of toxicological, environmental fate and environmental exposure data as is atrazine. As such, Syngenta sponsored an independent panel of scientists to conduct a refined probabilistic assessment of atrazine consistent with the recommendations of ECOFRAM. This document, Aquatic Ecological Risk Assessment of Atrazine - A Tiered Probabilistic Approach (2) is being submitted to the EPA at this time and is included in Appendix 3. Also submitted at this time are additional summary and analysis of the available environmental fate data (3) and the results of refined, higher tiered surface water exposure modeling (Novartis, 2000a), as well as a risk assessment of endocrine system responses in several aquatic organisms (5), and a sex ratio study of daphids (6).

- The preliminary risk assessment should be revised to incorporate higher tiers of risk assessment, such as recommended by ECOFRAM and included in the Panel report (2).

- The Panel's assessment is consistent with some of the findings of the EPA at the lower tiers, however, when all available data are considered and refined assessment tools are applied, the assessment concluded that

  "The integration of an unusually comprehensive data set including laboratory bioassays, field microcosm studies, simulation modeling, and environmental monitoring revealed that atrazine does not pose an ecologically significant risk to most aquatic environments in North America. Although direct toxic effects on aquatic animals are very unlikely to occur, some inhibitory effects on algae, phytoplankton or macrophyte production may occur in certain habitats vulnerable to agricultural runoff. These effects are likely to be transient and recovery would be rapid. The Panel has considered and identified uncertainties associated with this assessment." (2).

- Within the draft RED, (Atrazine Effects Characterization, General, p. 11) a citation of a study by Giddings et al. 2000 is included. References were not provided in the draft, but this citation may refer to a poster presentation at the annual meeting of the Society of Environmental Toxicology and Chemistry (SETAC) in November 2000. The poster was a synopsis of an extensive review of more than 30 aquatic microcosm and mesocosm studies with atrazine. Contrary to the statement on p. 11 of the draft RED, the review was not limited to effects on biomass and primary productivity, but also considered effects on species abundance and recovery, community structure (including diversity), and direct and indirect effects on invertebrates, fish, and water quality. The microcosm and mesocosm studies cited by EFED were included in the review by Giddings et al. Most of the reported effects at low atrazine concentrations were found to be unreliable for a variety of reasons, and inconsistent with the much greater body of evidence from other studies.

- Syngenta is providing a review and analysis of the acute and chronic toxicity data for 92 species of aquatic plants and 82 species of aquatic animals within the probabilistic assessment (Giddings et al. 2000). When toxicity data are available for a large number of species, as in this case, it is appropriate for the risk assessment to be based on the distribution of species sensitivity rather than on the extremes of the distribution.

- Within the draft RED, (Summary of Major Risk Concerns, p. 7 and elsewhere) is the statement “continued atrazine use is likely to pose a risk to health and integrity of some aquatic communities”. The conclusions of the higher tiered risk assessment coupled with the long history of atrazine use in North America suggests that the Agency’s statement is misleading at best.

- Within the draft RED (Environmental Risk Conclusions, pp. 3, 58, 60 and 74 and numerous other locations) are statements inferring to the use of atrazine results in habitat loss to terrestrial and aquatic animals. The statements concerning terrestrial organisms are conjecture and not based on scientific data. Additionally, the draft RED includes citations of Kettle et al. **(1987)** several times (pp. 11, 21, and 58) when noting potential indirect effects to aquatic organisms. The inferred effects of this research at 20 μg/L were anomalous results that cannot be confirmed from the published data and were discounted in subsequent publications by the same researchers. Therefore, technical flaws in the study design preclude its use in the preliminary risk assessment, and these references should be removed.

- The suggestion of indirect effects to endangered species from atrazine use (Environmental Risk Conclusions, p.3 and elsewhere) is not supported by the scientific evidence. The FIFRA Endangered Species Task Force (of which Syngenta is a participating member) is working in cooperation with the EPA and US Fish and Wildlife Service via a Cooperative Research and Development Agreement (CRADA) which will be used to determine potential exposure to endangered species when necessary. Syngenta supports the full protection of the nation's endangered species and will accomplish this through implementation of this EPA program.

- The results by Moore and Waring (1998) on salmon behavior are associated with a great deal of uncertainty with the concentrations used and some of the conclusions drawn from this study. There is no evidence to indicate atrazine affects salmon reproduction or homing behavior. The uncertainty surrounding this study shows it to be inappropriate for use in a risk assessment. Any assessment of the potential impacts should also consider the very low use and potential exposures of atrazine near salmon waters. Guideline studies on fish health and reproduction confirm large margins of safety associated with environmental concentrations of atrazine.

- The environmental fate data of atrazine, (laboratory and field data from the open literature as well as the Syngenta database) was extensively reviewed for the purpose of evaluating the available data for use in higher tier modeling. The primary dissipation routes of atrazine are biological and chemical. Aerobic laboratory soil metabolism and terrestrial field dissipation half-life values are comparable and dependent upon soil and environmental conditions. Conservative half-life values were calculated from laboratory data for exposure modeling. Regression equations were developed that estimated site-specific soil degradation rates and absorption constants. Based upon physiochemical data and sorption coefficients, atrazine is not expected to adsorb strongly to sediments and may partition only moderately from the water column. It should be noted that when field dissipation data were evaluated (both Novartis generated reports and public domain literature; 89 studies were evaluated and 21 met criteria to be able to make comparisons) using kinetic methodology the field dissipation half-life values were substantially lower than those cited in the RED. While the field dissipation data presented in the RED were adequate, there are more refined methods for calculating kinetics available today than when many of the original studies were conducted. The weight of evidence of these 21 studies more accurately reflects the true half-life of atrazine under field conditions and should be used in the Agency's revised assessment.

- The draft RED states that "atrazine is associated with endocrine disruption (Environmental Risk Conclusions, pp. 3 and 11 and elsewhere). Although endocrine modulation in wildlife species by xenobiotics is a relatively new area of investigation, Syngenta has voluntarily undertaken investigations to consider the potential for atrazine to function as an endocrine modulator in wildlife species. An independent panel of university scientists were requested to examine the available literature relative to endocrine disruption in fish, amphibians and reptiles and a copy of their report is included in this submission (5). This Panel concluded that based on the available data, atrazine did not pose a significant threat to aquatic wildlife, however, they also noted a lack of data in certain areas. As such, Syngenta has continued laboratory investigations and Panel assessment and will provide reports when completed. Partial presentation of these data have been made these studies demonstrated no effects on sex ratio, development or survival from realistic nest exposures to atrazine (7).

- The draft RED mentions increased fetal resorptions in mammals occurring from 7 days of exposure (Environmental Risk Conclusions, p. 3). This statement is not supported by any documentation or additional information within the draft RED. Additionally, the mammalian studies cited in Appendix XI do not support this statement since the duration of treatment in these studies was 11 days and dose concentrations are much greater than could be found in the environment.

- The draft RED cites Dodson, et al., 1999 as evidence of atrazine endocrine disruption (Atrazine Effects Characterization, p.11). This work reports effects on Daphnia sex ratios at extremely low concentrations of atrazine. Subsequent work (6) (current submission) failed to duplicate this finding, and provided an alternative explanation for the 1999. Results of numerous microcosms and mesocosms at much higher rates have failed to suggest effects on invertebrate sex ratios.

- The topic of mixture toxicity and synergy is also a relatively new environmental scientific issue. The draft RED states that a "number of authors have reported toxic interactions for plants between atrazine, its dealkylated degradates and other pesticides (Environmental Risk Conclusions, p.3). The currently submitted risk assessment (2) includes an assessment of the likely risk to aquatic organisms from mixtures of atrazine, its' degradates and other herbicides. Unlike many published works, actual monitoring data was employed to ensure environmental relevant mixtures were considered. This analysis indicated degradates of atrazine contribute little to the total potency of mixtures of atrazine and metabolites. Furthermore, the analysis suggests that atrazine, compared to the other triazines contributes little to the total toxic potency of mixtures of all triazines, except at concentrations which are well below those identified as being toxicologically or ecologically relevant, or in locations where few of the other triazines are used. It was recognized by the Panel that atrazine co-occurrence with other triazines in the monitoring data sets is limited.

- The draft RED references a number of ecological incident reports (pp. 41, 42, and 71-73). Syngenta only receives a portion of the total incidents obtained by USEPA, but disagrees with the interpretation of this information in the RED. The EPA notes the lack of toxicity associated with atrazine but contends that effects cited in the incident reports could be due to indirect or synergistic effects. As noted above, there is not scientific data to support these theories. Syngenta would like to formally request for transparent with the data that was used to generate the draft RED analysis. The draft RED includes a non-scientific approach when commenting on the incident reports. Given the widespread and frequent use of atrazine, it is probable that incidents were reported not from effect but through coincidence of occurrence.

  The draft RED does not report the number of years encompassed by the number of incidents but cites either 61 or 114 incidents. EPA should specify the years for which indicent reports are available. For 40 years of use the incident numbers reported are extremely low.

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- EPA's Draft Risk Assessment of Atrazine apparently utilized crop use information from the mid-1980s for the evaluation. This is inappropriate because actual atrazine use has significantly changed in the last 15 years. At that time, atrazine and cyanazine were the only significant preemergence broadleaf products in corn, and postemergence products were limited to 2,4-D, bromoxynil, and dicamba. Atrazine was used as the primary broadleaf product at high rates to control the complete broadleaf spectrum. Since then, there has been the introduction of several broadleaf products, and while atrazine is still used on approximately 70% of the corn acres, its use rate is less than in 1985 when the average rate was estimated at 1.96 lbs. ai/A. Atrazine stewardship programs were also initiated and the average atrazine rate has further declined for the years 1995-2000. This was accomplished by label changes and changing herbicide use patterns. Specifically, several crops and non-crop uses have been deleted, and the maximum rate for specific crops has been reduced. For example, the 1984 maximum corn label rate was 4.0 lbs. ai/A compared to the 2000 maximum of 2.0 lbs. ai/A as a single application, or 2.5 lbs. ai/A/yr. as a combined preemergence and postemergence treatment, with significant rate limitations depending on soil erodibility plus application prohibitions on vulnerable land near water. Current estimates of the average rate in corn are in the 1.1 lbs. ai/A range, thus resulting in an approximate 45% average atrazine rate reduction in corn. In corn alone, this 0.86 lbs. ai/A reduction on 50 million acres equates to a 43 million pound reduction in atrazine use. Rates have been significantly reduced in sorghum, and such high rates as the 40 lbs. ai/A non-crop use has been dropped. Up-to-date atrazine information according to uses on the current labels should be utilized in the risk assessment.

  Within a preliminary lower tier assessment it is appropriate to consider worst case scenarios. As such the draft RED includes risk assessment with aerial applications. In fact, aerial application of atrazine in all crops (corn, sorghum, and sugarcane) is a minor percentage of total applied. Furthermore, the average atrazine rate when applied by air in corn, 0.86 lbs. ai/A, sorghum 1.16 lbs./A, and sugarcane 1.67 lbs./A.

Introduction

Syngenta Crop Protection, Inc. (formerly Novartis Crop Protection, Inc.) appreciates the opportunity to provide comments on the preliminary environmental fate and effects risk assessment for atrazine, provided by the EPA in the letter to Janis McFarland dated December 8, 2000 (received by Syngenta on December 9, 2000).

This response is structured to roughly follow the outline of the EPA's document, although where an item are located in more than one section of the RED, we have addressed it but once in the General Comments Section. Specific comments to point out errors/omissions, etc. are contained in a separate section of the document. Included as appendices are several documents, including the Expert Panel's comments on the draft RED, a label mitigation history, The Expert Panel's report (2), and additional references cited in the text of our comments. Also, note that a separate data submission containing the report cited herein as (2), is being provided concurrently to the Agency under separate cover as a formal data submission. This report is included in Appendix 3 of our comments. Also contained are several additional reports that contain pertinent information that should be utilized in revisions to the risk assessments.

The chemical atrazine has been an important weed control tool for American farmers for over 40 years, and continues to be the choice for use in reduced tillage and no-till systems for corn and sorghum. The comments included in this document, focus on errors as requested by the Agency, the accuracy and appropriateness of exposure inputs for the various documents used for the risk assessment, and suggestions for improving the risk assessment process through the use of a higher tier risk assessment to reduce uncertainty. Given the enormous amount of scientific research available on this chemical, this higher tier risk assessment process should be utilized.

If the draft RED is significantly revised or any other new information is added which Syngenta has not yet received, we request an additional comment period prior to it's use in the publicly released draft risk assessment. Additionally, Syngenta respectfully reserves the opportunity to comment on citations requested from the Agency since they are unavailable for review.

It should be noted that due to the nature of the regulatory process, our focus within this response is on identification of errors and disagreements and not on the areas of agreement which are contained in the draft RED.

General Comments by Topic

Atrazine Labels, Usage, and Biological Activity

The draft RED does not present accurate information concerning current use rates, use patterns and usage information of atrazine in several instances. These are listed in the Specific Comments section of this document. Syngenta has not yet received the BEAD, May 10, 1999 QUA analysis. Furthermore, much of the water monitoring data cited within the EPA preliminary assessment does not reflect the numerous changes in use pattern and application rates that have occurred since voluntary mitigation measures were initiated by Syngenta in 1990,1992 and 1996. In addition to lowering maximum use rates, a number of uses were deleted, application set-backs or buffers around water bodies (lakes, reservoirs, streams, and rivers) were added to the product labels. Also, many other changes were made to minimize the potential for atrazine to leave the treated area and runoff to surface water. A detailed list of these changes is included in the Appendix 2 of our comments. Since the implementation of these measures, water quality improvements have occurred in many water systems in the atrazine use areas of the U.S., which is in part reflected in the results of extensive surface water monitoring provided to EPA by Syngenta and many other organizations in the last five years.

These factors were considered in the higher tiers of the recently submitted probabilistic risk assessment (2) and the EPA should conduct an updated exposure assessment that reflects more current information and a more refined atrazine ecological risk assessment. The draft EPA assessment utilizes water exposure values that are not reflective of actual exposures to aquatic environments over time, and tend to suggest much more severe ecological effects than are actually occurring from labeled use of atrazine.

Some draft RED examples of inaccurate use rates and usage information that affect the accuracy of the ecological risk assessment include the following.

Page 4: 1st Paragraph under Chemical and Usage, Line 3; “At the highest use rates it is a non-selective herbicide” is no longer correct. Syngenta no longer supports such high atrazine use rates and this should be removed.

Page 5, 1st Paragraph, Line 1; “About 60 million acres of total corn are treated with about 63 to 75 million lbs. ai per year.” The last sentence in this paragraph has “72 million acres”. This would calculate to 83% of US corn acres (60 divided by 72 X 100 = 83%) of corn acres getting an atrazine treatment, which is incorrect. This is much higher than survey results, including those of NASS where 69-70% of corn acres are receiving atrazine treatments for the last several years. Syngenta respectfully requests the opportunity to review the QUA conducted by BEAD, dated May 10, 1999, and also an explanation of the weighting procedures used with the various data sources in determining percent of crop treated.

Page 5, 1st Paragraph, Line 2; “The maximum label rates for corn are 0.84 to 3.0 lbs. ai/A.” Atrazine labels for corn do not exceed a total of 2.5 lbs. ai/A per year with a single maximum application rate of 2.0 lbs. ai/A. Higher rates are not supported.

Page 5, 1st Paragraph, Line 6; “…corn – 1.0 lbs. ai/A (with an average of 1.1 applications on about 82 to 97 percent of the 72 million acres).” This estimate of 82 – 97 % crop treated is in error, based on NASS data and Doane Marketing Research. As noted above the NASS range is around 70% annually.

Page 5, 2nd Paragraph, Line 2; “The maximum label rates for sorghum are 1.3 – 3 lbs. ai/A with ….” Syngenta and most other registrant’s atrazine labels do not exceed a total maximum of 2.5 lbs. ai/A. Higher rates are not supported.

Page 5, 3rd Paragraph, Line 1; “Sugarcane is treated with about 2.5 to 5 million lbs. ai per year on about 76 to 100 percent of the total 855 thousand US acres.” It is not realistic to use 100% as the maximum percent of acres treated across the states of FL, LA, TX, and HI.

Page 5, 4th Paragraph, Line 1; “Other registered crop uses include; …..” A list of crops and sites are then presented. The following crops and non-crop sites are not on Syngenta labels, are no longer supported by adequate residue or other required data, and should not be used in the risk analyses: barley, hay, oats, pasture, pineapples, rice, rye, winter wheat, rangeland, grasses grown for seed, total vegetation control in non cropland and industrial sites. Also note that for barley, oats, and rice, tolerances do not exist in 40 CFR and to our knowledge, atrazine has never been registered for these crops.

Page 8, 3rd Paragraph, Line 5; “Inasmuch as essential vegetation in treated areas, such as right-of-ways, …”   The right-of-way use, as characterized by EPA, is not on the Syngenta atrazine labels, and is not supported by data for registration. Our atrazine product labels allow an application of 1 lb. ai/A to roadsides for weed control, but at that rate, desirable vegetation is maintained.

The risk assessment should be refined to reflect the cumulative distribution (by acreage) of atrazine use rates on corn and sorghum (Table 1). This cumulative distribution is determined using the Doane Marketing Research Inc. database with atrazine corn/sorghum use defined as number of acres treated with specific rate increments of atrazine. Data is obtained on atrazine as an active ingredient, irrespective of whether it is the single active ingredient applied, in prepack formulations, in tank mixtures with other active ingredients, or applied sequentially with other active ingredients. The maximum Syngenta application rate of atrazine is 2.0 lbs. ai/A as a single application, or 2.5 lbs. ai/A/yr. as combined preemergence plus postemergence applications. It is commonly used alone and in prepack formulations at rates less than these. However, to capture all possible uses, two categories for rates higher than those supported by Syngenta labels were included. The rate range from 0.0 kg ai/ha to 3.36 kg ai/ha (0.0 lbs./A to 3.0 lbs. ai/A) were defined into 12 increments and these intervals capture all Syngenta label rates, some label rates higher than those supported by Syngenta and the extreme, if any, that are in the database.

This process used to determine total rate per base acres, can be further defined for preemergence rates, postemergence rates, preemergence only rates, postemergence only rates, and the respective preemergence and postemergence rates when the acres receive both preemergence and postemergence applications. The resulting information is at the national and state level, and the states were grouped according to EPA geographical regions.

From the number of acres receiving a specific rate increment, a percentage of the total acres per geographic area is calculated to get a distribution of acres receiving specified rates. These are then cumulated across rate increments as reported in Table 1 for comparative purposes are then per region versus national total. The same type of information is determined for sorghum in Table 1.

Table 1. Cumulative Distribution (By Acreage) of Atrazine Use Rates on Corn and Sorghum, 1998

Survey Rate (kg a.i./ha)	Corn (cumulative % of acres)					Sorghum (cumulative % of acres)[a]			
	Northeast	Midwest	South	West	National	Midwest	Southern	West	National
0.0 - 0.56	4.83	7.37	2.55	9.33	6.60	2.42	2.62	3.84	2.51
0.56 - 0.67	8.88	14.91	5.64	16.41	13.34	7.72	17.30	9.95	11.42
0.67 - 0.90	16.09	31.73	13.71	35.01	28.53	13.40	27.86	19.52	19.02
0.90 - 1.12	28.44	41.13	17.83	40.50	37.22	21.21	32.74	45.92	25.93
1.12 - 1.40	51.56	60.22	36.80	61.99	56.50	42.68	68.76	93.93	53.30
1.40 - 1.68	71.05	72.75	60.23	76.57	70.93	66.95	78.90	94.30	71.86
1.68 - 1.96	78.37	83.92	67.11	88.84	81.34	74.91	80.60	94.30	77.32
1.96 - 2.24	90.36	92.86	89.78	97.33	92.39	87.58	90.22	97.30	88.70
2.24 - 2.52	95.95	94.73	92.11	98.19	94.46	92.48	90.22	97.30	91.66
2.52 - 2.80	96.51	96.34	94.66	98.87	96.15	94.22	94.58	97.30	94.39
2.80 - 3.36	97.78	98.46	98.78	100	98.51	97.19	97.17	99.17	97.20
> 3.36	99.99	100	100	100	100	99.99	99.99	99.99	99.99
Area-weighted[b]	1.60	1.46	1.77	1.38	1.51	1.70	1.49	1.28	1.62

[a] No data available for Northeast.
[b] Area-weighted application rate (kg a.i./ha)

Data compiled for Novartis by Doane Marketing Research.

General Information on Aerial Application of Atrazine

Acreage and pounds of atrazine applied by aerial application in corn, sorghum, and sugarcane show little use in 2000. These values are very small when considered as a percent of the total market for a given crop.

For example, there are only 216,508 corn acres in the US having aerial application of atrazine. For sorghum there were 337,304 aerial atrazine acres and for sugarcane there were 10,610 acres. These values correspond to 0.4% of the atrazine corn base acres having an aerial application. The percent aerial acres for sorghum and sugarcane are 5.5% and 1.4%, respectively. These low values for corn and sugarcane approach the limits of valid results.

Atrazine Fate Characterization

➢ **Laboratory Data**

The Agency notes that atrazine enters the atmosphere via volatilization and spray drift. Based upon atrazine's physicochemical properties, volatilization of atrazine from soil surfaces and water is not likely. Atrazine has a low vapor pressure, 2.89×10^{-7} mm-Hg at 25 °C (Vapor Pressure, AG-87/38P), and a low Henry's Law Constant, 2.48×10^{-9} atm m^3 mol^{-1} (9). The log of the octanol/water partition coefficient of atrazine is 2.68 at 25 °C (10). The solubility of atrazine in pH 7 buffered water at 22 °C was determined to be 33 mg/L (11). Due to the unavailability of the data cited, Syngenta cannot verify whether the estimated atrazine aerial deposition is based on air/rain samples taken from the edge of field, and/or how frequently the air/rain samples were collected to derive an annual value of total deposition. Extrapolation from infrequent yet in-situ field air/rain samples to estimate annual aerial deposition can cause substantial errors. Particularly given the low volatility, gaseous phase atrazine is unlikely significant while small liquid droplets or dust-bound atrazine may be possible in the ambient air shortly after application. However, transport of these particulates far away from its origin is likely limited.

Aerobic Soil Metabolism: Extensive research has been performed over the past thirty plus years to determine the fate and persistence of atrazine. Approximately seventy references, including studies available in the public domain, summaries, books, and unpublished studies, were evaluated for potential data on the transformation of atrazine (3). Research performed on soil in a controlled, laboratory environment under similar experimental conditions were the focus of the search. Six studies, representing ten unique atrazine half-life values, were considered representative of the degradation of atrazine. These values are presented in Table 8. Numerous studies were not considered for the following reasons; extremes in experimental conditions (e.g., temperature and soil moisture); the soil was fabricated in the lab (vs. field collected); the soil was amended with bacterium or an energy source; the study was an outdoor, field study; or, the analytical procedure, extraction method, and/or, detection limits did not generate acceptable results. The half-life values in Table 8 ranged from 20 to 146 days with a mean value of 44 ± 38.6 days (3).

If two or more laboratory values are available, the USEPA uses the t-test equation to calculate a conservative half-life value for use in exposure modeling (12). The resultant approaches the mean as the sample size increases. Decay rates in surface soils were calculated using reported aerobic soil metabolism half-lives for the ten values summarized in Table 8. Using the t-test equation, the aerobic soil metabolism half-life was estimated as 61 days. The mean aerobic soil metabolism half-life value of 61 days reported by Burnett, et al., 2000 should be used in the risk assessment.

Anaerobic Aquatic Metabolism: The literature search demonstrated that there are only a limited number of studies assessing the anaerobic degradation of atrazine in the sediment phase of lakes or ponds. Available data from laboratory anaerobic soil studies were used in the estimation of the degradation in the sediment phase (3). Typically, these studies are performed either by flooding the pond soil or sediment and maintaining under anaerobic conditions, or by converting an aerobic experiment to anaerobic conditions after 30 days of aerobic conditions. Results of available data for atrazine under anaerobic conditions is summarized in Table 7. Data from the Wassnaar experiment (13) was not considered since the subsoils were stored for 1.5 years at 10 °C prior to use and, as the authors pointed out, may have slowed down the microbial transformation. In Table 7, the half-life values for atrazine in the sediment phase ranged from 58 to 547 days with an average value of 228 ± 168 days. Using the t-test equation, 311 days was determined to be a conservative half-life value for atrazine degradation in benthic sediments. The reported mean anaerobic metabolism half-life value of 311 days (3) should be used in the risk assessment.

- **<u>Field Dissipation</u>**

Within the draft RED, (Atrazine Exposure characterization-General, p. 9-10) many references are given that describe atrazine as being persistent for more than one year. The Agency cites one investigation, i.e., Armstrong, et al. 1967, as indicative of the persistence of atrazine in soil. The EPA further cites the investigation's atrazine half-life value of "...exceeding 1 year under some conditions..." The noted half-life value was an extrapolated data point. In the same investigation, i.e., Armstrong, et al. 1967, an atrazine half-life value of 95 days is noted, under some conditions. The Armstrong (et al. 1967) investigation is not representative of the biotransformation of atrazine since the investigation was performed using perfusion systems, sterilized soil and some soil free systems. Also soil application rates in the study were as high as 47.7 ppm which was >10X the total atrazine load. For comparison, 4 ppm is equivalent to approximately a 4 lb. ai/A treatment (assuming 10^{-3} inch soil depth). Also there were literature citings concerning runoff where the cited atrazine concentration (4700 µg/L) in bulk field runoff at the edge of the treated field (Wauchope, J. Environ. Qual., Vol. 7, no. 4, 1978, 459-472) does not represent reality in normal agricultural practices. That result was obtained under man-made extreme conditions (40 m^2 plot with 14% slope). Atrazine was applied to soil surface at 9 Kg/ha). As a general comment, literature citations should be of strudies conducted under environmentally relevant conditions and at dose rates comparable to those supported by our current labels.

Within the draft RED, (IV. Environmental Fate Assessment page 43-46). Many studies listed in the literature reviewed for the RED were outdated. While these studies may accurately describe some of the degradation mechanisms for atrazine, the field dissipation should be considered for rates that are supported by our current registered label rates. Also, there are more refined methods for calculating the kinetics associated with the degradation of compounds than were available when many of the older studies were conducted. Another difficulty in reviewing literature is knowing exactly how the kinetics were derived. In a recent and extensive review of literature both laboratory and field studies were evaluated and the environmental fate profile was assessed. In this review, where possible, data were all evaluated using the same kinetic techniques, thereby allowing a more accurate comparison. Below are exerpts from the summary that describe the literature review. Please refer to the Environmental Fate Summary (3) for details and a list of the literature that was reviewed.

Individual degradation routes such as soil metabolism, hydrolysis, photolysis and aquatic degradation are more accurately defined in laboratory studies. However, total dissipation can only be evaluated in a natural field environment. Therefore, a "weight of evidence" approach was attempted to first quantify the gross field dissipation half-life of atrazine, then to qualitatively compare them to the laboratory-derived half-life values. Data were selected on the basis of criteria such as dose rate, adequate methodology.

The dissipation of atrazine was analyzed by nonlinear first-order regression. The regression was performed on the non-transformed mean concentration values using SigmaPlot (Version 5.0, SPSS, Inc., San Rafael, CA). The equation used to fit the data was:

$$C = yo + ae^{-bt}$$

where "C" is soil concentration, "t" is time, "b" is a rate constant, "yo" and "a" are regression constants.

Resultant half-lives ranged from 8.2 to 99 days (3).

Atrazine Exposure Characterization

- **Monitoring Data**

Pages 34-35. Insufficient information is given to determine which NAWQA sites the conclusions are based on, so it is impossible to verify the analysis. Most NAWQA sites gather data intensely for three years. Thus the values plotted amount to 3-year maxima, or daily values with a probability of exceedance of 1 in 1095 - approximately 99.9^{th} percentile values. Comparing these with chronic exposures is not scientifically valid.

The claim that NAWQA data are not specifically designed to match atrazine applications may be true, but in fact the sampling is focused on the late spring and summer months, and therefore is biased toward high atrazine values compared to representative sampling, which is not "likely to underestimate the concentrations" as stated.

Table 2

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Number of NAWQA samples*	247	329	321	448	841	941	639	773	230	136	155	129
Ratio with December	1.91	2.55	2.49	3.47	6.52	7.29	4.95	5.99	1.78	1.05	1.20	1.00
Three seasons	25.9% of all samples				61.6% of all samples				12.5% of all samples			

*Data for all NAWQA stations, 1992 to 1996, representing 1420 station-years

- **<u>Exposure Modeling</u>**

Page 16, Exposure Characterization (Pond): The following comments are also applicable to the tier II PRZM/EXAMS modeling on page 53-54 and Appendix V.

a) The sugarcane scenario in the draft RED was based on pre-plant aerial application in Louisiana at two rates 3.9 and 4 lb. a.i./A (see page 53). However, based on Doane Marketing Research data, there is no pre-emergence aerial applications on sugarcane in Louisiana and little post-emergence aerial applications (<0.7 % acreage). No aerial applications have been found in other two major sugarcane states FL and TX. Ground and banded applications are the two common practices in these states. Thus, tier 2 modeling on sugarcane scenario should be calculated using ground or banded application.

b) The 20-year's historical weather data is too short to derive the annual upper 10^{th} percentile EECs for the sugarcane scenario (Appendix V, page 8). The full available 36-year's historical weather data should be used.

c) The average Koc (87.78) of 4 soils determined by the adsorption/desorption batch equilibrium study was used for all the three scenarios. However, there is a large amount of published literature has demonstrated that soil clay minerals play an important role in binding the atrazine molecule (e.g., Laird et al., Soil Sci. Soc. Am. J., Vol. 56, page 62, 1992; Environ. Sci. Technol., Vol. 28, page 1054, 1994). Based on published atrazine Kd values of 49 soils, Syngenta recently developed a significant regression relationship (r^2=0.96) between Kd and soil properties including organic carbon content (OC, %), pH, and cation exchange capacity (CEC, meq./100 g) (3):

$$\mathbf{Kd = 0.644 + 3.353*OC - 0.471*pH*OC + 0.0331*CEC*pH}$$

Given the range in soil texture in the three scenarios, particularly the sugarcane scenario with the soil type Sharkey clay, the risk assessment should use the established regression to directly estimate Kd based on specific soil properties rather then a simplified average Koc value in the refined modeling run.

d) The soil metabolism half-life (146 days) based on a single study should not be used in the refined modeling work. Instead, given the availability of published data, a refined soil half-life based on the EPA proposed method (the t-test value at 90% confidence) should be derived and used. This value is 61 days (3).

e) To further verify justifications on field hydrology conditions, weather station location, application dates, etc., Syngenta respectfully requests the detailed PRZM input files.

f) Other PRZM Input Parameters: Recommend using the values from (3) 122 days for anaerobic soil, and 311 days for anaerobic aquatic. EXAMS Input Parameters: The risk assessment should be revised to use the correct Henry's Law Constant and vapor pressure, 122 days for KBACW, 311 days (from reference 3) for KBACS, and the Koc input from above (comment #C).

g) The refined modeling should consider the effect of pond water overflow on EXAMS results. A simple examination is to compare the annual runoff volume with the total pond volume. Effect of overflow should be taken into account if the yearly runoff volume is larger than the pond. Syngenta respectfully requests detailed PRZM runoff output and precipitation data to further verify the models used in the risk assessment. However, Syngenta believes such comparison is critical to avoid logical fault in numerical modeling.

Page 20, 1st paragraph: Concern that perfect mixing as assumed by the standard pond scenario may cause under-estimation of potential local high concentration at the edge nearest the treated field, may be over-stated. Mixing of inflows to the pond resulting from runoff can be a much quicker process than mixing in a static water body due to intrusion of the incoming water into the pond and accelerated eddy (turbulent) dispersion (Fischer et al., Mixing in Inland and Coastal Waters, Academic Press, Inc., 1979).

Page 16 and Others: The EPA uses a typical sugarcane application rate of 3.9 lbs. ai/A in the exposure characterization. However, the atrazine sugarcane label allows flexibility of application timings and rate selection based on specific field needs. Therefore, the type of application and application rate can vary. The typical surgarcane use rate ranges from 2 to 3 lbs. ai/A, based on a 1998 Doane market analysis and communications with growers. Syngenta requests that the assessment be revised to reflect these realistic application rates when conducting higher tiered PRZM/EXAMS modeling.

Atrazine Effects Characterization

As stated previously, the submitted probabilistic risk assessment (2) includes a comprehensive review of all available toxicity aquatic toxicity data for atrazine. This review entailed an evaluation of the reliability and relevance of the reported acute and chronic toxicity values. Data for a total of 92 plant species and 82 animal species were incorporated into the final assessment. Consistent with the recommendations of the EPA Office of Water, geometric means of toxicity values were used when multiple values existed for single species.

A major difference in approach between the higher tier analysis of (2) and that of the Agency is the use of species (and other taxonomic groupings) distribution as an expression of the toxicity of atrazine. This approach is recommended by ECOFRAM as appropriate in higher tiers of refinement. Syngenta will largely defer additional comments on atrazine effects data, pending the EPA opportunity to review the submitted probabilistic assessment but requests that this new information be considered in the finalization of the RED.

It should be noted however that we disagree with the interpretations and/or use of several referenced reports which we believe to be erroneously interpreted and detailed comments are provided in (2), or will be provided during the public response period. For example, the EPA assessment endpoint for non-vascular plants is considered to be 1 µg/L, based on a 1976 report of decreased chlorophyll production by algae in a laboratory study. Within the submitted assessment an analysis, based on standard algal toxicity endpoints, indicated that the 10^{th} centile of sensitivity among 45 species of freshwater and saltwater aquatic plants was 33 µg/L, consistent with the proposed EPA water quality criterion of 49 µg/L.

The RED's summary of pond mesocosm effects on animals (Environmental Risk Assessment, p. 58) contains only one reference: Kettle et al. (1987). The inferred effects at 20 µg/L reported in this paper were anomalous results that cannot be confirmed from the published data and were discounted in subsequent publications by the same researchers. The summary of pond microcosm effects on plants (p. 59) cites only Kettle et al. (1987) and Hoagland et al. (1993). The lowest exposure concentration in these two studies was 15 µg/L (Hoagland et al. 1993).

The RED cites several studies suggesting synergistic interactions of atrazine and a number of other pesticides. Additional comments specific to these studies will be subsequently provided. The currently submitted risk assessment (2) includes an assessment of the likely risk to aquatic organisms from mixtures of atrazine, its degradates and other herbicides. Unlike many published works, actual monitoring data was employed to ensure environmentally relevant mixtures were considered. This analysis indicated degradates of atrazine contribute little to the total potency of mixtures of atrazine and metabolites. Furthermore, the analysis suggests that atrazine, compared to the other triazines contributes little to the total toxic potency of mixtures of all triazines, except at concentrations which are well below those identified as being toxicologically or ecologically relevant, or in locations where few of the other triazines are used.

- **Reported Olfactory Response**

The following refers to EPA comments on pages (4, 74, 75, XIII-2). In several sections throughout the RED potential impacts on salmon are cited (preliminary study by Moore and Waring 1998). The statement that effects occurred at concentrations as low as 0.5 μg/L is in error. As noted by Moore and Waring (1998) and the EPA (page XI-14), atrazine concentrations measured in the study are not accurate due to sampling design, delays in analysis, and degradation. Additionally, no analyses of exposure concentrations were referenced in the paper and no detail of how these solutions were made up and whether solvents were used was given. Therefore, it is difficult to ascertain the actual concentrations salmon were exposed to in the experiments and any reference to this study should be revised to reflect this uncertainty.

Moore and Waring (1998) make some questionable statements in their discussion. The authors suggest that atrazine is a highly lipophilic substance that would bioaccumulate in the lipid-rich testes. The BCF/BAF data for fish in the literature (12) do not support this statement. Additionally, the effect of the olfactory epithelium is ascribed to inhibition of AChE by atrazine. This unlikely mechanism is based on suspect research conducted at nominal concentrations up to 12,000 times higher.

The EPA states that atrazine concentrations will be at their peak during salmon spawning runs. However, atrazine exposure to salmon would be minimal in the Pacific Northwest. Compared to other regions of the United States, the Pacific Northwest would be considered a “low-use area” (2). Therefore, the probability of occurrence of atrazine during salmon runs is likely low.

Therefore it is not appropriate to infer any reproductive or homing impact on salmon from Moore and Waring (1998). Any reference to this study should reflect the uncertainty.

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- **Endocrine Modulation**

Page 11, Atrazine Effects Characterization, General – Two papers are cited in the document on potential endocrine disrupting effects of atrazine in wildlife Dodson et al. (1999) and Petit et al. (1991). The findings of Dodson et al. (1999) have not been replicated in a subsequent study conducted under GLP guidelines (Hosmer et al. (6)). The estrogenicity and vitellogenin (Vg) induction assays conducted by Petit et al. (1997) showed 16.51% inhibition of binding to the rainbow trout estrogen receptor. However, this effect was within the range observed with the solvents used to dissolve the atrazine (14.0 to 17.94%) and could have merely been a solvent-induced artifact in the assay. Vg induction was 3.3% of control, greater than the values reported for the solvent (0.1-1.4%) but, as no statistics were performed, their statistical significance is unknown. Other studies presented to EPA at the Science Advisory Panel (SAP) in June 2000 confirm the lack of interaction with the estrogen receptor.

<u>Atrazine Risk Assessment</u>

- **Terrestrial Animal Risk Assessment**

The following refers to EPA comments on pages 3,7,8, 62-67, IX – 2-5, XI – 3,4,6,7. The chronic toxicity values used for the small mammal assessment are incorrect. The EPA states LOAEL and NOAEL values of 50 and 10 ppm, respectively, from reductions in pup body weight, however, the correct LOAEL is 500 ppm and the correct NOAEL is 50 ppm (MRID No. 40431303). The toxicology chapter of the RED dated 11/15/2000 contains a review of this study (MRID No. 40431303) with the appropriate toxicity values:

> " …Parental body weights, body weight gain, and food consumption were statistically significantly reduced at the 500 ppm dose (HDT) in both sexes and both generations throughout the study. Compared to controls, body weights for F_0 HDT males and females 70 days into the study were decreased by 12% and 15%, respectively while F_1 body weight for the same time period was decreased by 15% and 13% for males and females, respectively. The LOAEL is 500 ppm (39 mg/kg/day in males, 42.8 mg/kg/day in females) based on decreased body weights, body weight gains and food consumption. The NOAEL is 50 ppm (3.78 mg/kg/day in males, 3.7 mg/kg/day in females).
>
> "There did not appear to be any reproductive effects from compound exposure. Measured reproductive parameters from both generations did not appear to be altered in a dose-related manner."

The chronic toxicity values used for the avian assessments are incorrect. The RED Chapter states an LOAEL and NOAEL for bobwhite quail and mallard of 225 and 75 ppm, respectively, however the correct LOAEL is 675 ppm and the correct NOAEL is 225 ppm. The correct values are based on core guideline studies for both the bobwhite quail (MRID No. 42547102) and mallard duck (MRID No. 42547101). These studies were originally reviewed by Charles Nace and Michael Whitton of KBN Engineering and Applied Sciences Inc. 02/15/93 and approved by James Goodyear of USEPA on 01/06/94. A summary follows:

> **MRID NO. 42547101**
> "This study is scientifically sound and fulfills the guideline requirements for an avian reproduction study. Egg production, egg hatchability, adult food consumption and adult male body weight were significantly decreased in the 675 ppm a.i. group, when compared to control values. The NOEC was 225 ppm a.i. (nominal concentration)."
>
> **MRID No. 42547102**
> "This study is scientifically sound and fulfills the guideline requirements for an avian reproduction study. The NOEC was 225 ppm a.i. (nominal concentration), based on reduced egg production and embryo viability at 675 ppm a.i."

Syngenta also disagrees with several other parameters used in this risk assessment. The foliar half-life of atrazine stated by EPA on page 62 of the document is incorrect for the granular formulation. Following irrigation of the turf, the dissipation half-life of atrazine at the Florida test site was 6 **hours**, not 6 **days**. This was obtained from fitting the field data to a nonlinear exponential decay regression equation where a high regression coefficient (0.98) indicated excellent fit. The data from the irrigated test plot at the Georgia site was so variable that it could not be fitted with any confidence to a regression model, and, thus, a half-life could not be obtained. Therefore, the half-life of 10.5 days stated in EPA's document is of such low confidence that it should not be used, especially given the fact that the data from the Florida site are of higher quality and provide a high confidence half-life. The statement that irrigation increases the half-life of atrazine by 20 to 54% is erroneous; clearly, irrigation reduces the half-life of atrazine (average of 6 days with no irrigation versus 6 hours with irrigation).

The use of 17 days as the foliar half-life for liquid sprays is not appropriate. It is apparent that the last sampling point at the Georgia site (21 days after treatment) does not follow the decline trend seen with the previous 4 sampling points and is therefore questionable. When this data point is removed from the data set, the regression analysis shows the half-life to be approximately 5 days which correlates well with the 3 day half-life obtained at the North Carolina test site. The average half-life of 4 days is the appropriate value to use in assessing risks to birds and animals potentially ingesting atrazine-sprayed foliage.

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➢ Plant Risk Assessment

It is not appropriate to assess chronic risk based on peak Kenaga exposure values: long-term exposure to atrazine-treated foliage as a food source is unlikely since plants treated with atrazine, a herbicide, would die rapidly and become unattractive as forage items.

The typical sugarcane use rate is 2.5 to 3.0 lbs. ai/A based on a 1998 market analysis and communications with growers, not 3.9 lbs. ai/A as stated by the EPA. Contacts in Florida gave a typical single broadcast application rate range of 2.0 to 3.0 lbs. ai/A or 2.5 to 3.0 lbs. ai/A depending on source. These ranges are applicable for preemergence and postemergence applications. The individuals contacted represent a large percentage of the sugarcane acres in Florida, so their estimates should be considered as “real” use rates.

The following refers to EPA comments on pages 8,9, 67-69, X – 1. The risk quotients calculated in the RED for non-target terrestrial plants in dry and wet areas following aerial application and in wet areas following ground application are inconsistent with those calculated by Syngenta. Using an application rate of 4 lb. a.i./A, solubility of 33 ppm, and runoff value of 2%, standard EFED exposure values (Appendix X in the RED) and RQs were calculated:

Aerial	Drift (5%) = 0.2 lb. a.i./A
	Loading to Dry Areas (drift + runoff) = 0.248 lb. a.i./A
	Loading to Wet Areas (drift + runoff) = 0.68 lb. a.i./A
Ground	Drift (1%) = 0.04 lb. a.i./A
	Loading to Dry Areas (drift + runoff) = 0.12 lb. a.i./A
	Loading to Wet Areas (drift + runoff) = 0.84 lb. a.i./A

Table 3. Risk Quotients were corrected using the above exposure values and the toxicity values listed in the RED.

Atrazine Risk Quotients for Terrestrial Plants (4 lbs. ai./A; Aerial Application)				
	Risk Quotients in Dry Areas		Risk Quotients in Wet Areas	
Crop	Typical	Endangered Species	Typical	Endangered Species
Carrot	83	99	227	272
Oats	62	99	170	272
Ryegrass	62	50	170	136
Lettuce	50	50	136	136
Onion	28	50	76	136
Cucumber	19	50	52	136
Soybean	1.3	10	3.6	27
Cabbage	18	25	49	68
Tomato	7.3	25	20	68
Corn	< 0.06	< 0.06	< 0.2	< 0.2

Table 4

Atrazine Risk Quotients for Terrestrial Plants (4 lbs. ai./A; Ground Application)		
	Risk Quotients in Wet Areas	
Crop	Typical	Endangered Species
Carrot	280	336
Oats	210	336
Ryegrass	210	168
Lettuce	168	168
Onion	93	168
Cucumber	65	168
Soybean	4.4	34
Cabbage	60	84
Tomato	25	84
Corn	< 0.21	< 0.21

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➢ Endangered Species Concerns

The following refers to EPA comments on pages 3,60,73-75, and Appendix XIII 1-2. Direct and indirect concerns to endangered species from atrazine use are cited. Potential indirect effects to endangered species and indirect effects to terrestrial organisms are not based on scientific data. Additionally, the EPA cites Kettle et al. **(1987)** several times when noting potential indirect effects to aquatic organisms. The inferred effects of this research at 20 µg/L were anomalous results that cannot be confirmed from the published data and were discounted in subsequent publications by the same researchers. Additionally, the comparison of the discounted 20 µg/L effect concentration from the Kettle et al. (1987) study to stream exposures is inappropriate. Exposures in stream are much shorter than in ponds where this chronic assay endpoint was observed. Statements concerning indirect habitat effects from labeled atrazine use are in error and should be removed from the risk assessment.

Syngenta is a charter member of the FIFRA Endangered Species Task Force which is working in cooperation with the EPA and US Fish and Wildlife Service via a Cooperative Research and Development Agreement (CRADA) which will be used to determine potential exposure to endangered species when necessary. Syngenta supports the full protection of the nation's endangered species and will accomplish this through implementation of the EPA's program.

➢ Ecological Incident Reports

The EPA lists a contradictory number of incident reports (6(a)(2)) in the draft RED: 61 on page 41 and XI-73 and 109 on page 72. Syngenta only receives a portion of the total incidents obtained by USEPA, but disagrees with the interpretation of this information in the RED. Syngenta would like to formally request the data that were used to generate the EPA analysis. Additionally, Syngenta assumes reports were collected over the past decade since no dates were given by the EPA. Therefore, Syngenta requests EPA to include the total number of years that were used to calculate the number of incidents, or, preferably, identify the incidents by year. The Agency should briefly describe the conservative nature of the 6(a)(2) data/process to the public and when referencing a particular study describe all contributing factors (e.g. other pesticides in the use area).

Of the incidents cited, atrazine residues were analyzed in only one and the source of toxicity was attributed to an organophosphate, profenofos. The EPA states “the inference of these reported incidents to atrazine effects is likely do to the wide spread use of atrazine and the proximity of the atrazine application and timing to the occurrence of the incident.” However, the EPA also indicates “given the low toxicity of atrazine to fish, aquatic invertebrates and mammals, the reason for the frequency of effects to these organisms is uncertain”, implying the ecological risk assessment and scientific studies designed by, reviewed by, and required by the Agency are somewhat inaccurate.

The EPA also states that the incident reports imply indirect ecological effects or synergism with other pesticides. However, given the type of data and the multiple stressors present in an incident report, such statements are not supported. Additionally, a number of the cases cited are associated with crop damage, and by nature are not ecological incidents.

In summary, the draft RED has associated atrazine use to a number of incidents in a subjective manner. Although, Syngenta has not had the opportunity to review the data, the incidents are likely due to circumstances related to atrazine. Therefore, Syngenta contends that given the relatively small number of reports in the EIIS compared to its extensive use indicates atrazine does not pose significant risks.

- **Water Assessment**

Page 3, Environmental Risk Conclusions – Atrazine concerns - bullet 1. Atrazine was not detected in 97.2 percent of the finished water samples (93,660 of 96,324) collected from 20,934 Community Water Systems (CWS) on groundwater in the 31 atrazine major use states (98 percent of annual use in U.S.) over a 7 year period (1993-1999). These data have been submitted to EPA- OPP in October, 2000 in a report entitled Human Exposure to Atrazine and Simazine Via Groundwater and Surface Drinking Water:Update VI (MRID 45253401). Also, the national EPA Pesticide CWS and rural well survey in the later 1980's showed a low frequency of occurrence for atrazine of less than 1.0 percent. The vast majority of the detections from rural well surveys conducted by USGS and state agencies in mid-1990 show the vast majority of wells (93 to 100 percent) with detections less than 0.50 ppb. These data have been submitted to EPA-OPP in March, 2000 (MRID-45058704) in section 3 in report entitled Human Exposure to Atrazine and Simazine Via Groundwater and Surface Drinking Water: Update V.

Page 3, Environmental Risk Conclusions – atrazine concerns, bullet 4. The concern about rainfall posing risks to non-target plants can be addressed rather directly by an analysis of average atrazine concentrations from rainfall storm events, compared to the non-target plant NOEL and or LOEL for the most sensitive species tested. The amount of atrazine in rainfall, based on monitoring studies, is typically less than 1.0 gram per acre. Thus, atrazine concentrations in rainfall do not add significant quantities to the soil through precipitation. As in flowing surface water, exposure to atrazine in rainfall is seasonal with peak concentrations in the early spring and summer. Also, the highest concentration of atrazine tends to occur during the first part of the rainy period with declining concentrations in closely associated subsequent rainfall events. It appears, even within a rainfall event, the atrazine concentration declined over time. The atrazine concentrations in rainfall events decline to very low levels in early summer and are below levels of detection usually from August through the fall and winter months. A weight of evidence biological assessment of atrazine in rainfall should be conducted. Based on an analysis of the monitoring data and plant toxicity data, the concentrations in rainfall are not expected to pose any adverse ecologically effect on terrestrial plants.

We have submitted for the Agency's review a Syngenta Technical Bulletin 1-1993 entitled "Biological Assessment of Atrazine and Metolachlor in Rainfall prepared in 1992-93 to help evaluate the monitored concentrations of atrazine in rainfall and potential exposure to aquatic and terrestrial plants (Appendix **xxx).**

Page 21, Exposure characterization (lakes and reservoirs) is incomplete in the presentation of data on lakes and reservoirs and therefore, misleading to the reader. The two cited references are the exception and not typical maximum levels observed in reservoirs and lakes. This section should be expanded to show the distribution of maximum concentrations for lakes/reservoirs reviewed by EPA. It should also show quarterly and annual means for the reservoirs and lakes EPA has reviewed for this assessment. Two maximum values for two lakes/reservoirs do not provide a balanced, or accurate exposure characterization for lakes/reservoirs in the United States.

Page 21, Atrazine concentrations in Community Water Systems (CWSs). The assumption that the raw water concentrations of atrazine had higher detections than noted in ARP listing of CWS on bottom of p. 21 and top of p. 22 is not correct for the CWS listed. These CWS for the years listed did not use PAC/GAC and the concentrations noted are also reflective of raw water.

Page 22, In the Table with CWS with high atrazine concentrations from PLEX database. The CWS of Hillsboro (1994), Drexel (1994), Gillespie (1996), Sardinia (1996), Monroeville (1997) and Newark (1997) should be included. The other CWS listed under Hillsboro and Gillespie purchase finished water from the two CWS. Thus, there are 6 CWs included in the table directly obtaining raw water from a reservoir. From an ecological exposure characterization, there are 6 reservoirs rather than 16 as shown in this table.

Page 22, Risk characterization – surface water sources for Community Drinking Water. The assumption is made that raw water for the 6 CWS (not purchasing CWS) listed in PLEX table on p. 22 would be higher than maximum atrazine concentrations noted on p. 22 due to PAC/GAC treatment. This assumption is not correct. Since the CWS for the years noted were not using PAC/GAC during this time period.

Pages 22-24, USGS 1992-1993 Study of Midwestern Reservoirs (USGS Open File Report 96-393). The Figure 4 and Figure 5 of maximum atrazine concentrations in 1992 and 1993 for the 76 reservoirs used alone are not sufficient to accurately characterize the ecological risk. Other exposure periods are required for assessment over the 17-month period. For example, period time-weighted atrazine means did not exceed 5.00 ppb in any of the 76 reservoirs. The maximum period mean was 4.22 ppb and 54 percent of the reservoirs (41 of 76) had period means less than 1.0 ppb.

Page 24, Risk Characterization for 76 Mid-western Reservoirs/Lakes is in error. The discussion on page 24 implies the maximum concentration would be present throughout the 17-month period. Also, it infers the single study endpoints of 1.0 and 10.0 ppb apply equally to all algae and invertebrate species in the lakes and ignores the comparative differences in sensitivity to atrazine.

Pages 24-31, Exposure Characterization (Streams). The analysis has the same error in the stream characterization as in the reservoir/lake analysis. The comparison of maximum atrazine concentrations to selected endpoints that infer this effect occurs continually throughout the year in stream segments.

Pages 36-41. The analyses for Louisiana and Chesapeake Bay are inaccurate due both to endpoints and use of only maximum atrazine levels to assess chronic risk to aquatic life. The full use of the data sets over a temporal period (seasonal, annual and multi-year) combined with full set of acute and chronic endpoints showing the range in sensitivity to atrazine need to be used to assess the ecological effect on these specific water systems.

Pages 46-50, Drinking Water Assessment. Syngenta commented on drinking water exposure in the EPA-HED draft Health Effects Risk Assessment for the Atrazine RED. The reader should be referred to that document, filed by Syngenta on December 22, 2000. The discussion in this environmental fate and effects chapter on drinking water (pp. 46 –50) should be qualified to explain use of drinking water data for exposure estimates.

Page 21-22. ARP database: In this database only 16 of 9417 finished water samples (and 12 of 1829 raw water samples) exceeded 20 µg/L.

Table 5

Location	% of samples exceeding 20 µg/L	Time-weighted mean concentration	90^{th} % ile concentration (Syngenta report)*	Time-weighted 90^{th} % ile concentration
Gillespie	8.93	3.90	12.12	16.96
Shipman	12.00	5.21	12.86	19.80
North Vernon	3.85	3.21	17.48	12.00
Logansport	2.63	1.35	4.91	2.81
Flora	2.00	2.19	8.49	5.54
Monroeville	1.56	1.30	3.84	2.94
All ARP finished water	0.17	N/A	N/A	N/A
All ARP raw water**	0.66	N/A	N/A	N/A

* Raw water or finished water without treatment that would substantial reduce atrazine concentrations.
**Cannot be directly compared with finished water because it involves a different set of stations and different time spans.

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- **Rural Well Survey**

Page IV –2, 3, and 4. Rural Well Survey:
In the Rural Well Survey conducted by Syngenta Corporation during the period from September 1992 to March 1995, 8 out of the 1505 total surveyed wells (0.53%) had atrazine concentrations ≥3 ppb, i.e., the first 8 wells in Table 1 (17491-KS-017, 17491-KS-068, 17491-MN-003, 17491-WV-033, 17491-IN-050, 17491-WI-080,17491-WI-045, 17491-WI-060). Six wells (0.40%) including 2 wells in the 8 highest atrazine wells (i.e. 17491-WI-045 and 17491-WI-060) exceeded the total chloro- atrazine 12.5 ppb, the chronic DWLOC for infants based on the new body weights recommended by EPA Office of Water (OW). Two wells had total chloro- atrazine close to 12.5 ppb (i.e., 17491-WI-092 and 17491-WV-019). However, only one well (0.066%) in the entire survey (17491-WI-045) was slightly exceeded (18 ppb).

Follow-up investigation on the 8 highest atrazine detection wells by Syngenta Corporation indicated that point source contamination might have contributed to the higher than expected concentrations of atrazine. Among the 8 wells, two were not used for drinking water. The deethylatrazine to atrazine ratios (DAR) in 8 wells were all significantly below unity (Table 1), indicating that the parent atrazine might have moved to ground water preferentially from point sources (Adams, C.D., and E. M. Thurman. 1991: Formation and Transport of Deethylatrazine in the Soil and Vadose Zone. J. Environ. Qual. 20:540-547). It is to be expected that under normal leaching conditions, atrazine degrades to DEA resulting in larger DAR if residues are found in ground water. DAR should be larger than unity because deethylatrazine is the primary degradation product of atrazine and has lower soil Koc relative to the parent.

For the 8 highest total chloro- atrazine wells (two approaching 12.5 ppb), one was not a drinking water well and three had no recorded use of atrazine at least for 5 years prior to the sampling dates in the area where the wells were located (Table 6).

Since the majority of the sampling activities for the concerned wells listed in Table 6 took place during 1992 to 1993, the beneficial effect from the last major use rate reduction of atrazine during the 1993 season and thereafter was probably not fully reflected in this study. For example, subsequent sampling and analysis of the 2 wells in PA resulted in significant reduction in the concentration of atrazine plus its chlorinated metabolites, decreasing total concentration from 14 and 15 ppb to 7.6 and 6.8 ppb, respectively. The two WI wells, 17491-WI-084 and 17491-WI-092, were found with atrazine concentrations reduced, from 2.3 and 1.0 ppb in 1992 to 0.32 and 0.58 in 1996, respectively. The total chloro-atrazine residues were reduced from 13 and 12 ppb to 3.13 and 3.71 ppb during the same time period in the two wells, respectively. Given the survey was designed with well selection criteria strongly biased toward worst-case such as previous detection, high hydrogeological vulnerability, and proximity to field of atrazine application history, the rural well data are generally not appropriate for a population-based regional/national scale drinking water assessment.

Only one well (out of 1505 sampled in the Rural Well Survey) had a total chloro-triazine concentration equaling 18 µg/L. As indicated in the follow-up investigation, this well likely had point source contribution to the detection of high atrazine concentration (>3 ppb). Among the 6 wells with atrazine <3 ppb but with total chloro-atrazine > or close to 12.5 ppb, some of the wells had re-sampled results showing reduced both atrazine and total chloro-atrazine concentrations far below 12.5 ppb (e.g., 17491-WI-084 and 17491-WI-092). Although no follow-up sampling data is available for the few other wells, these were not drinking wells or were located in areas of no recorded atrazine use for at least 5 years prior to sampling. The high chloro-atrazine metabolite concentrations in these wells, thus cannot rule out possibilities of historical point source contamination in these areas, since high level of atrazine might have degraded to chloro-atrazine metabolites in the interval between last contamination and sampling.

Finally, results from the National Alachlor Well Water Survey (L. Holden and J. Graham et al., Environ. Sci. Technol., Vol. 26, No. 5, 1992, 935-943) indicated that the MCL exceedance frequency of atrazine in private, rural domestic wells was less than 0.1% which is 5 times lower than the results from the Ciba Rural Well Study (i.e., 0.5%). The National Alachlor Well Water Survey was conducted in 1987-1989 with a statistically designed sampling method for well selection to represent approximately 6 million private rural wells in corn and soybean production areas in the United States. Ciba/Novartis PLEX database also contains information on atrazine detection in rural non-community system wells in 21 major atrazine use states. The PLEX database indicated that atrazine was detected above 3.0 ppb in only 0.15% of private rural wells (25 out of 16,382) which is very similar to the results from the National Alachlor Well Water Survey.

Table 6

Well ID	County	**Sampling Date**	Atrazine (ppb)	Total chloro- (ppb)	DAR	Well Use	Year Well Bored	Well Depth (ft)	Distance to Field (ft.)	Atrazine Last Used	Years Used
Wells exceeding 3 ppb atrazine but less than 12.5 ppb total chloro-atrazine											
17491-KS-017	Harvey	06/14/94	5.1	6.2	0.12	OTH	1976	35	75	1994	90-94
17491-KS-068	Washington	11/30/94	3.8	4.5	0.16	D/O	1977	78	150	1991	90-91
17491-MN-003	Winona	08/23/93	3.4	5.6	0.41	D/O	1940	285	70	1993	93
17491-WV-033	Jefferson	09/13/93	4.2	6.3	0.24	OTH	1960	160	2640	1993	89-93
17491-IN-050	Jasper	8/19/93	9.1	11	0.15	DOM	1963	18	150	1992	90, 92
17491-WI-080	Dane	11/24/92	4.3	6.4	0.28	DOM	1920	60	Unk	1989	89
Wells exceeding both 3 ppb atrazine and 12.5 ppb total chloro-atrazine											
17491-WI-045	Sauk	10/13/92	12.0	19	0.39	DOM	1972	150	50	1988	88
17491-WI-060	Sauk	10/28/92	7.0	13	0.67	DOM	1952	95	40	Not	Not
Wells exceeding or close to 12.5 ppb total chloro-atrazine but less than 3 ppb atrazine											
17491-WI-084	**Richland**	12/1/92	2.3*	13*	2.00	DOM	1986	46	850	Not	Not
17491-WI-092	Dodge	12/7/92	1.0**	12**	2.50	DOM	Unk	75	100	NA	NA
17491-WV-019	Jefferson	8/9/93	0.96	12	3.44	DOM	1978	140	80	1993	89-9***3***
17491-WV-039	Jefferson	9/14/93	0.69	14	3.77	OTH	1955	20	300	1993	89-93
17491-PA-105	Franklin	6/28/93	1.4	15	3.57	D/O	1960	240	15	1993	89-9***3***
17491-PA-106	Franklin	6/28/93	1.7	14	2.76	DOM	1943	160	35	Not	Not

DAR = Deethylatrazine to Atrazine Ratio; D/O = Domestic or Other; DOM = Domestic; OTH = Other.
Atrazine Last Used = Year atrazine was last used at the sampling location.
Years Used = Years atrazine was used in the five years preceding the time of sampling at sampling location.
Not = Atrazine not used.
NA = No information available on atrazine use.
* Concentrations reduced to 0.32 ppb for atrazine and to 3.13 ppb for total chloro- atrazine after resampling August 5, 1996.
** Concentrations reduced to 0.58 ppb for atrazine and to 3.71 ppb for total chloro- atrazine after resampling August 6, 1996.

The EPA discussions of this topic ignores several available items, and/or has the following problems:

Data Requirements

Aquatic Photodegradation, end of second paragraph: The Agency requested additional information. The requested information was provided to the EPA (2-3Q 1992) by fax as ABR-92031; however there was no MRID number assigned.

Atrazine draft data were provided as part of the Spray Drift Task Force data base submitted to the EPA. In Appendix XIV (page XIV-2), "Data Requirement Tables, 158.440 Spray Drift", for guidelines 201-1 Droplet Size Spectrum and 202-1 Drift Field Evaluation the table contains contradictory indications on data requirements. Please clarify.

In Appendix XIV (page XIV-1), "Data Requirement Tables, Dissipation Studies-Field", under the column heading "Does the EPA Have Data to Satisfy This Requirement (Yes, No or Partial)", the table indicates "no" for guideline 164-2 Aquatic (Sediment). The table also indicates "yes" for this guideline requirement under the column heading "Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)?" Syngenta is not aware of any labeled aquatic uses for atrazine and therefore questions why additional data would be required as indicated in this table.

The EPA lists multiple study requirements for atrazine degradates (pages XI-1, 3, 4, 6, 12, 13, 19, 21, 23, 24, 27, 28, and XIV 3-5). Whereas few degradate toxicity studies have been conducted on terrestrial animals, multiple studies have been conducted with aquatic organisms. Toxicity data is available for deethylatrazine, deisopropylatrazine, diaminochlorotriazine, hydroxyatrazine, desisopropylhydroxyatrazine, and diaminohydroxyatrazine. These studies (some of which are referenced in pages XI 40-41) indicate that the toxicity of atrazine degradation products is less than for parent atrazine.

Table 7. Anaerobic Aquatic Metabolism

Soil – Sediment Texture Class	Soil – Sediment Series	Soil – Sediment Origin	Study Conditions	Water pH	% OM	Study Temp (°C)	Study Rate (ppm)	Half-life (days)	Ref.
Sandy Clay	NR	GA	Natural pond water/sediment	7.2	0.2	25±1	10.1	330	Spare, 1987
Loam	NR	CA	Flooded soil	7.6	1.4	25±1	10	159	Nelson, 1991
Sandy Loam	NR	Germany	Paddy water flooded soil	6.5	3.79	25	10	77	Keller, 1978
Silty Clay	NR	LA	Wetland water/sediment	6.3	5.27	20-24	10	224	Chung, 1996
Sand	Borgerswold	Netherlands	Ground water flooded subsoil	5.7	0	10±1	0.02	332	Van der Pas, 1998
Sand	Papenvort	Netherlands	Ground water flooded subsoil	4.5	0.1	10±1	0.019	547	Van der Pas, 1998
Sand	Genderen	Netherlands	Ground water flooded subsoil	7	0.5-1.0	10±1	0.02-0.04	58	Van der Pas, 1998
Sand	Genderen	Netherlands	Ground water flooded subsoil	7	0.5-1.0	10±1	0.02-0.04	95	Van der Pas, 1998
							Mean:	228	
							Std. Dev.:	168	
							N:	8	
							Median:	192	

OM = Organic Matter
NR = Not Reported

Table 8. Aerobic Laboratory Soil Metabolism

Soil Texture Class	Soil Series	Soil Origin	% Soil Moisture[a]	Soil pH	% Soil OM	Study Temp (°C)	Study Rate (ppm)	Half-life (days)	Ref.
Sandy Loam	Hanford	CA	12	6.05	0.74	25 ± 1	10	26.6	Singh, 1990
Loamy Sand	Tujunga	CA	4	6.3	0.57	25 ± 1	10	22.9	Singh, 1990
Silt Loam	Falaya	TN	80 (FMC @ 1/3 bar)	5.5	0.66	25	5.6	21	Winkelmann, 1991
Silt Loam	Falaya	TN	80 (FMC @ 1/3 bar)	5.5	0.66	25	1	20	Winkelmann, 1991
Sandy Loam	Cape Fear	NC	80 (FMC @ 1/3 bar)	5.3	5.1	21 ± 2	1	59.3	Blumhorst, 1994
Loam	Les Evouettes	Switzerland	75 (FMC @ 1/3 bar)	6.8	6.38	20	10	56.4	Abildt, 1991
Loam	NR	CA	75 (FMC @ 1/3 bar)	7.6	1.4	25 ± 1	10.2	146	Nelson, 1991
Silty Loam	NR	Germany	60 (MWHC)	5.1	2.2	25	5	39.4	Qiao, 1996
Silty Loam	NR	Germany	60 (MWHC)	7.6	1.8	25	5	24.9	Qiao, 1996
Sand	NR	Germany	60 (MWHC)	4.1	3.8	25	5	23.8	Qiao, 1996
							Mean:	44	
							Std. Dev.:	38.6	
							N:	10	
							Median:	25.8	

[a] Soil moisture during incubation.
OM = Organic Matter.
NR = Not reported.
FMC = Field Moisture Capacity.
MWHC = Maximum Water Holding Capacity.

SPECIFIC COMMENTS/CORRECTIONS SUGGESTED

Page 2, Table of Contents - A list of tables and figures should be included. The page numbers for all sections should be checked. Note that the Appendix is not correctly numbered i.e., goes from IX to XI.

Page 2, Table of Contents - A list of tables and figures should be included. The page numbers for all sections should be checked.

Page 4, line 18 - A Figure 2-1 is referenced, but does not appear anywhere in the report.

Page 4, 2nd Paragraph, Line 4; "… a carbamate insecticide and other herbicides." EPA should site the references where the synergism has been reported. Syngenta is not aware of this issue as being of any significance, given the many years of use of atrazine with carbamates.

Page 4, 1st Paragraph under Chemical and Usage, Line 1; "Atrazine … has the largest poundage of any herbicide and is widely used to control grasses and many other weeds." This should be changed to "Atrazine … is the second largest poundage herbicide and is widely used to control broadleaf and many other weeds, primarily in corn, sorghum, and sugarcane."

Page 4, 5th Paragraph, Line 7; "Atrazine formulations include dry flowable, flowable liquid, liquid, water dispersible granule, and wettable powder." The draft RED should also include coated fertilizer granule as a formulation type.

Page 4, 5th Paragraph, Line 8; "The maximum registered (should add the words {single application}) use rate for atrazine is 4 lbs. ai/A; and 4 lbs. ai/A is the maximum (add the word – single) application rate for the following uses: … ". Note that softwoods, right -of-way/fence -rows/hedges, are not on the Syngenta label, and are not supported for re-registration.

Page 5, 3rd Paragraph, Line 2; "The maximum label rates for sugarcane are 3.4 to 4 lbs. ai/A …." This should be changed to – The maximum single application rate ….".

Page 5, Mechanism of Action - Although the mechanism of action of atrazine is described, the most important point is missed - that is the reversibility of the inhibition of photosynthesis (Kline et al., 1996).

Pages 7, 62-67, and XI 6-7: The chronic toxicity values used for the small mammal assessment are incorrect. The EPA states LOAEL and NOAEL values of 50 and 10 ppm, respectively, from reductions in pup body weight, however, the correct LOAEL is 500 ppm and the correct NOAEL is 50 ppm (MRID No. 40431303). The toxicology chapter of the RED dated 11/15/2000 contains a review of this study (MRID No. 40431303) with the appropriate toxicity values.

Pages 8, 62-67, and XI 3): The chronic toxicity values used for the avian assessments are incorrect. The RED states an LOAEL and NOAEL for bobwhite quail and mallard of 225 and 75 ppm, respectively, however the correct LOAEL is 675 ppm and the correct NOAEL is 225 ppm. The correct values are based on core guideline studies for both the bobwhite quail (MRID No. 42547102) and mallard duck (MRID No. 42547101). These studies were originally reviewed by Charles Nace and Michael Whitton of KBN Engineering and Applied Sciences Inc. 02/15/93 and approved by James Goodyear of USEPA on 01/06/94.

Page 9, 3rd Paragraph, Line 5; "These data provide a strong basis for concluding that the continued use of atrazine is likely to result in adverse effects on some aquatic communities." This as a stand-alone statement does not convey the fact that atrazine has been extensively used for over 40 years, with no know adverse effect on aquatic communities. The "likely to result in adverse effects" statements is incorrect.

Page 17, Table of "Percent of Pesticide Loading from Different Sources to the Standard Pond." This presentation of data is not transparent and the reader cannot ascertain its accuracy.

Page 40, Multi-Paragraphs; Concerning Chesapeake Bay literature has citations implicating atrazine, the Agency should update this discussion to show atrazine not the cause of the situation (Hall, 1999).

Page 41, 2nd Paragraph, Lines 3 and 6; "Incidents. In only one case, a cotton use,…." Atrazine is not registered for use on cotton (extremely phytotoxic to cotton), so whatever caused the effect in that incident, it could not have been atrazine. Also, in Line 6; "Other non-target organisms affected include grasses and on occasions; corn, …" Corn is not affected by atrazine with direct application at the maximum label rate of 2.0 lbs. ai/A, so the observed effect to corn would not have been caused by atrazine in the reported incidents.

Page 41: The EPA lists a contradictory number of incident reports (6(a)(2)) in the draft RED: 61 incidents are listed on page 41 and 109 incidents are listed on page 72.

Page 43: The Agency notes that the aerobic laboratory half-life value of atrazine is 3-4 months. However, a specific reference, source of this 3 to 4 months half-life value is not provided. In Appendix II, Aerobic Soil Metabolism (162-1), pages II – 1 and 2, five different studies are referenced, none of which report this half-life value. In fact, three of the referenced studies, MRID's 40431321, 40629303, and 42089906, are actually the same study, presented to the EPA at different stages of completion. MRID 40431321 is the preliminary report to the final study report, MRID 40629303; and MRID 42089906 is MRID 40629303 and two analytical reports (metabolite identification reports). The half-life should be 61 days.

Page 44: The Agency cites half-life values for a (one) anaerobic aquatic study. The values are correct, but it may be worthwhile to note in the discussion, data evaluation that was performed for the Panel and presented in Burnett, et al (2000).

Page 44: First sentence, third paragraph is inaccurate when compared to the Agency's table in Appendix II, page II-9. According to the EPA's table, this sentence should read:

> *Deethyl-atrazine (DEA; G-30033) and deisopropyl-atrazine (DIA; G-28279) were detected in all studies (Appendix (II), and hydroxy-atrazine (HA; G-34048) and diaminochloro-atrazine (DACT; G-28273) were detected in all but one of the listed metabolism studies.*

Hydroxyl-atrazine was not detected in all of the studies that the Agency has listed (Appendix II), which is contrary to the text on page 44. On page 44 the EPA does note that the metabolite levels were "…much less than 10% of applied…" but the table in Appendix II list the metabolites as "Major Degradates" and do not indicate levels detected. Only two metabolites, G-30033 and G-28273, were greater than 10% of the applied; this occurred in one study, soil phototysis.

Soil Photodegradation: The first paragraph, study MRID 40431320, the Agency references a study that OPP rejected November 1988. The more recently conducted study in the second paragraph, MRID 42089905, is the study Syngenta supports, and the draft RED should be corrected accordingly.

Page 62, 1st Paragraph, Line 2; "Risks from atrazine uses on sugarcane, corn and sorghum are assessed for maximum and typical use rates using the ." The sentence is incomplete.

Page 62, 2nd Paragraph, Line 5 and Line 8; "For granular applications, the atrazine half-lives are 4.9 (+/- 4.9) days (no-irrigation) and …." the dissipation half-life under irrigation uses 6 hours, not 6 days. "These data indicate fairly …and suggest that moisture from irrigation increases half-lives from granular formulation by 20-54%".

Page 64: The typical sugarcane use rate of 3.9 lb a.i./A is incorrect. Based on a 1998 market analysis and communications with growers, the typical sugarcane application rate is 2.5 to 3.0 lb a.i./A).

Page 72, 1st Paragraph, Line 12; “the majority of the incidents (about 35 percent) are listed as effects on corn mostly from corn applications. A number of the crop losses are large …..” It is highly unlikely that atrazine is the causative agent of corn yield loss. Atrazine has excellent selectivity to corn, even at excessive rates. Syngenta Technical Service Department records can show there are no complaints that atrazine causes corn injury. Later paragraphs on this page acknowledge that it is difficult to understand how atrazine is involved in the incident.

Page II-5, Appendix II: 1st, 2nd and 3rd Paragraph, Lines 3 and 3 and 3; Application rates for terrestrial field dissipation studies were 4.4, 18, and 18 lbs. ai/A, all of which are greater than label rates.

Page II-6, Appendix II: 1st, 2nd and 3rd Paragraph, Lines 3 and 3 and 3; Application rates for terrestrial field dissipation studies were 20, 4.4, and 3.96 lbs. ai/A, all of which are greater than current label rates in corn.

Page XI-1, Appendix XI, 2nd Paragraph, Line 1; “Since the lowest LD50 is in the range of 501 to 2000….” The lowest value in the Avian Acute Oral Toxicity table prior to this statement is 940. Syngenta questions the source of the 501 ppb value.

Page XI-6, Appendix XI, 2nd Paragraph, Line 3. “These degradates have LD50 values between 501 and 2000 mg/kg …..” The values in the Degradate Mammalian Acute Oral Toxicity table prior to this statement are 668 to 2290. Syngenta cannot determine the source of these values. Please provide this reference.

Page XI-6 and 7: The dose units in this table are incorrect. Doses were in mg/kg/day not ppm. This error also occurred in the Table on pages XI-8 and 9 for the atrazine degredates.

Page 9, paragraph 4, line 4 - The term tidal pond is used several times in the document. This term should be defined.

Page 9, paragraph 4, lines 4-6 - EPA states that a “multiple lines of evidence” approach was used to derive the final conclusion - high risk of atrazine to aquatic communities. This statement is incorrect because the EPA approach used to conclude high risk from atrazine exposure was a comparison of the highest environmental or modeled exposure concentration with the lowest toxicity values for various biological assemblages.

Page 11, first paragraph - The lowest acute atrazine toxicity value for rainbow trout is 4.5 mg/L (Bathe et al., 1975) not 5.3 mg/L. The lowest acute atrazine toxicity value for an estuarine fish is 2.0 mg/L for the sheepshead minnow at 25 ppt salinity (Hall et al. 1994) not 8.5 mg/L for the spot. The lowest acute value for an estuarine copepod is 0.092 mg/L for *Acartia tonsa* (Thursby et al. 1990) not 0.88 mg/L. All references for specific toxicity values should be listed in the text.

Page 12, Table 1 - The value for rainbow trout should be 5,300 ug/L not 53,000 µg/L. Note that there is a lower value for rainbow trout (4,500 ug/L).

Page 13, Table 1 - The reported acute EC50 value of 1 ug/L for algae by Torres and O'Flaherty (1976) is not an EC50 but rather a concentration that significantly decreased chlorophyll production after 7 days of exposure for three algal species (not five). This extremely low toxicity value, which has not been confirmed by numerous other plant toxicity studies with atrazine, drives the conclusions of EPA's risk assessment and is not based on a multiple lines of evidence approach that EPA proposes to use. Atrazine acute toxicity data are available for 45 plant species with a resulting 10^{th} percentile of 33 ug/L (2). A value of 33 ug/L based on numerous plant species is therefore more scientifically valid than an extremely low value of 1 ug/L reported from one study.

Page 13, Table 1 - The toxicity value for duckweed (*Lemna gibba*) of 37 ug/L is only one of 6 values for this species. The geometric mean for all 6 values is 62 ug/L.

Page 14, Table 2 - As noted above the 53,000 ug/L for rainbow trout should be 5,300 ug/L.

Page 14, Table 2 - See the above comment on the 1 ug/L value from the Torres and O'Flaherty (1976) paper.

Page 14, Table 2, non-vascular plants, stream study - The results from the Lakshinarayana et al. 1992 (reduction in primary production at 2.6 ug/L) are questionable and have not been confirmed by other studies.

Page 14, Table 2 - See above comment on the duckweed value of 37 ug/L.

Page 15, Table 3, first line for non-vascular plants - There are two values for *Isochrysis galbana* (22 and 200 ug/L). The geometric mean of both values is 66 ug/L.

Page 15. Table 3, second entry for non-vascular plants - The Bester et al. 1995 study that reports reductions in primary production at 0.12 ug/L atrazine is very questionable and has not been confirmed in other studies.

Page 16, Table 3 - Duration was not reported in the Cohn (1985) study with *Vallisneria*.

Page 18, figure 1 - The arrows for the second through fifth bullets are incorrect (pointing to the wrong effect benchmark).

Page 20, An Interpretation of the Results - As stated previously, in the draft RED there appears to be a continual theme of atrazine causing the loss of rooted aquatic plants, destruction of invertebrate and fish habitat and cascading effects throughout the food chain. This is not documented in any study conducted or submitted to the EPA to date, to our knowledge. This is in spite of more than 40 years of continuous atrazine use in the U.S.

Page 35, Risk Characterization (Streams in General) - Factors other that atrazine should have been addressed in the Lakshminarayana et al. (1992) stream study.

Page 35, last line - It should be Gruessner not Guessner.

Page 38 - Exposure Characterization for the Chesapeake Bay - There are more current atrazine monitoring data for atrazine in the Chesapeake Bay watershed.

Page 39, Risk Characterization for the Chesapeake Bay Monitoring Data - There is no evidence to show that atrazine is contributing to the decline of submerged aquatic vegetation in the Chesapeake Bay watershed. Suggestions by Correll et al. 1978 were not supported with data.

Page 43, paragraph 2 - The comment about inconsistency in concentrations showing effects from atrazine is best addressed by using a distribution of plant toxicity data as demonstrated in the Syngenta ecological risk assessment of atrazine (Giddings et al. 2000).

Page 17: Pond Risk Characterization: The draft RED uses wording that suggests that concentrations exceeded thresholds for entire years ("All years… exceed levels… ", etc). In fact the result only supports the statement that threshold concentrations were potentially exceeded at some time during the year, for as short a period of time as one instantaneous measurement.

Page 24. "Dilution and degradation usual reduce atrazine concentrations in streams within a few weeks of the rain event". In any but the larger rivers, storm runoff with high concentrations does not last more than a week, and in less than fourth order streams it rarely lasts more than four days. This statement confuses peaks associated with storm runoff with the more general peak associated with the year's application and runoff from all storms.

Page 25. Davies et al.: no concentrations are cited. Atrazine can be detected year-round at sub-ppb levels with modern analytical equipment. Without concentration profiles this citation is devoid of significance.

Pages 11-12: Text for Rainbow Trout 96-Hour LC50 is 5.3 mg/l, table on 12 has 53000 micro-g/l. these are not the same 5.3 mg/L = 5300 micro-g/L. The correct value is 5.3 mg/L.

Page 25: The draft RED cited a 635 ppb concentration, which is from an unpublished, non peer-reviewed source.

In the Appendices, under Product Chemistry of Atrazine and the Structures of Atrazine and Its Major Degradates and Metabolites, Syngenta has the following comments.

<u>Appendix I</u>; There are a number of inaccuracies:

1) MP: should be 175.8 °C
2) Vapor Pressure: should be 2.89 x 10^{-7} mm-Hg at 25 °C.
3) Density/Spec. Gravity: should be 1.23 g/mL at 22 °C.
4) Kow: should be 2.68 at 25 °C.
5) Solubility: concentration OK, temperature should be 22 °C.
6) Henry's Law: should be 2.48 x 10^{-9} atm-m^3/mole.

In the Appendices, under Summary of Guideline Environmental Fate Studies, Syngenta notes the following.

1) Bioaccumulation in Fish: The Agency incorrectly presents the BCF factors on page II-8:

	Edible	Nonedible	Whole
Page II-8	7.7	12	15
Correct Values	7.7	15	12

2) Degradates Detected in Laboratory Studies: The table presented on page II-9 uses the heading "Major Degradates." The EPA uses the term "major" to define a breakdown product that is ≥ 10% of the applied. Only two degradates, G-30033 and G-28273, barely attain this classification (13.3 and 11.9%, respectively) and in only one study, soil photolysis. The draft RED should include the actual amounts detected vs. using an "X." For example, under soil photo, degradates G-28279, G-34048, GS-17794, and GS-17792 were only detected in the study that OPP rejected.

Appendix II, page II-1: Aerobic Soil Metabolism - MRID 4041321 is the ‘interim report’ to MRID 40629303, which is the final report; MRID 42089906 is an Syngenta ‘summary report’ that includes MRID 40629303 and two supporting phase reports from Syngenta on degradate identification. This study is one of ten that is reported in (3). The other two studies noted in this draft RED MRID’s 00040663 and 40431322, were rejected by the EPA.

Appendix II, page II-2: Anaerobic Soil Metabolism - The draft RED should only use the reported final value. In the first paragraph the EPA discusses the interim report, in the second paragraph they discuss the final report, and in the third paragraph they discuss the summary report; it’s all the same study but the discussion is as if there were three different studies. In the second paragraph the Agency notes that the half-life value was not established in MRID 40629303. This is incorrect, the half-life value is reported on page 10 of MRID 40629303.

REFERENCES

(1) ECOFRAM. 1999. ECOFRAM Aquatic and Terrestrial Final Draft Reports USEPA WWW.EPA.GOV/OPPEFED1/ECORISK/INDEX.HTM, June 1, 1999.

(2) Giddings, Jeffrey M., Todd A. Anderson, Lenwood W. Hall, Jr., Ronald J. Kendall, R. Peter Richards, Keith R. Solomon, and W. Martin Williams, "Aquatic Ecological Risk Assessment of Atrazine – A Tiered Probabilistic Approach, A Report of an Expert Panel," Novartis Crop Protection, Inc., Greensboro, NC, Section 5.3.1.5, page 147, June 23, 2000.

(3) Burnett, Gene, K. Balu, Heidi Barton, Wenlin Chen, Bernie Gold, Peter Hertl, Dan Nelson, Peggy Scott, and Kim Winton, "Summary of Environmental Fate of Atrazine," Novartis Crop Protection, Greensboro, NC, Novartis Number 1213-99, June 23, 2000.

(4) Exposure Assessment of Atrazine in Surface Waters: A Tiered Probabilistic Modeling Approach; Study No. 376.01; (919)(1229-99, 400626). Novartis 2000a.

(5) A Risk-Based Assessment of Endocrine System Responses in Fish, Amphibians, and Reptiles to Atrazine; (919)(710-97, 72104). 1997.

(6) Effects of Atrazine on the Sex Ratio of *Daphnia pulicaria*; Study No. 45810; (919)(1201-99, 400233).

(7) Gross, T. S., J. J. Wiebe, V. Centonze, L. Centonze, T. Schoeb, and A. J. Hosmer. Effects of Atrazine Treatments of Freshwater Turtle Eggs: An Evaluation of Endocrine Disruption, Sex Reversal and Developmental Toxicity Effects. Presented at SETAC 20th Annual Meeting, Philadelphia, PA. November 14-18. 1999.

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(9) "Henry's Law Constant For Atrazine," CIBA–GEIGY Corporation, Greensboro, NC, ASGSR-88-51, July 15, 1988.

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Appendices

Appendix 1

COMMENTS ON PRELIMINARY ENVIRONMENTAL FATE AND EFFECTS RISK ASSESSMENT FOR ATRAZINE IN SUPPORT OF REREGISTRATION

5 January 2001

Jeffrey M. Giddings, Todd A. Anderson, Lenwood W. Hall, Jr., Ronald J. Kendall, R. Peter Richards, Keith R. Solomon, W. Martin Williams

We are the authors of the recently completed report “Aquatic Ecological Risk Assessment of Atrazine - A Tiered Probabilistic Approach A Report of an Expert Panel” (Giddings et al. 2000), which is included in the current submission. This report was a comprehensive analysis of the relevant toxicological and exposure data for atrazine in surface waters in North America. It enlarged upon an earlier assessment (Solomon et al. 1996) and included several levels of refinement of both exposure modeling and characterization of effects. This report is in the early stages of publication as a book through a professional scientific society where it will undergo a full, thorough, and open peer review process. Because of our familiarity with the subject matter, we (The Panel) were asked by Syngenta Crop Protection, through ECORISK, Inc., to respond to the “Atrazine RED - Draft Environmental Fate and Effects Chapter PC Code 080803", transmitted to Syngenta under a cover a letter dated December 8, 2000 from Richard Dumas.

Although the letter from Richard Dumas requested that only typographical and numerical errors be addressed at this time, the Panel notes that our report (Giddings et al. 2000) incorporates several innovative approaches that have been endorsed by ECOFRAM (ECOFRAM, 1999). We believe that the USEPA might find these useful in their re-drafting of the RED. Given the season and the short time for an initial response, we have focused herein on major issues of fact and interpretation. However, we will offer a more detailed and thorough review of the RED during the public comment period after its official release. Our comments are divided into general and specific with the latter grouped into those related to exposure, effects assessment, and risk assessment.

<u>General</u>

We utilized four levels of refinement in our risk assessment (Giddings et al. 2000) based on the recommendations of ECOFRAM (ECOFRAM 1999), as summarized in Table 1. Significantly, our risk assessment involved an extensive data collection effort beyond that in the draft RED. The risk assessment included four tiers of refinements to the exposure analysis as well as the use of concentration-response analysis and distributions of species sensitivity to characterize ecological effects. It also incorporated a comprehensive and critical review of field and microcosm studies and addressed the ecological risk assessment through multiple lines of evidence. The final conclusions of the Panel's risk assessment were that:

> "Monitoring data indicated that exposure models generally overestimated atrazine concentrations. Whole aquatic communities (in mesocosms and microcosms) are less sensitive to atrazine than the most sensitive species of plants and animals. Risk is extremely low for animals and is low for plants except in certain high-exposure situations (farm ponds and small streams in high-use, high-runoff areas). Effects in the high-exposure areas are likely to be transient and quick recovery of the ecological system is generally expected." (Giddings et al. 2000 and Table 1)

The Panel was gratified to note that the Agency has incorporated some levels of refinement in their preliminary environmental fate and effects assessment for atrazine. Unfortunately, the draft RED did not progress beyond a Tier I/Tier II level of refinement. As a result of relying on very conservative Tier I/Tier II approaches, the Agency has come to the conclusion that atrazine presents a general threat to the aquatic environment. The draft RED compared the distribution of annual maximum exposure data points against the lowest observed or most sensitive toxicological effect to derive a deterministic output which is extremely conservative. The objective of Tier I/Tier II is to identify potential hazards, which can then be evaluated more precisely in subsequent Tiers. A large and robust data set exists for both toxicological effects and environmental exposure for atrazine, as well as exposure data for atrazine, providing the opportunity to move from a deterministic approach to a probabilistic approach extending into Tiers III and IV in the risk assessment paradigm (ECOFRAM 1999). The Panel believes that, had the analysis in the draft RED been extended into higher Tiers, in which both the exposure analysis and effects analysis can be more accurately refined, it would have come to significantly different and more scientifically defensible conclusions with less uncertainty and been able to better characterize the rare occurrence of the high-risk situations indicated in Tier I. The Panel offers the following more specific comments.

Specific Comments

Model scenarios were well-constructed and provided a reasonable representation of atrazine use environments for an early tier exposure assessment. However, application methods represented in the scenarios are atypical for atrazine use practices. Applications occur predominately by ground for corn and sorghum. Only limited corn acreage is treated aerially and this occurs in the western fringe of the U.S. cornbelt. Model scenarios do not reflect label setback distances and natural attenuation factors that exist in the agricultural landscape, nor do they represent the distribution of use environments at large. Input parameter values on atrazine mobility and persistence do not reflect the robust environmental-fate data base that exists in the scientific community.

The draft RED often cites frequencies of detection of atrazine, for example in ground water or atmospheric samples. Frequencies of detection are strongly influenced by the available analytical technology and provide no ecologically meaningful information in the absence of data on the magnitude of the concentrations.

In discussing concentrations in surface waters, the draft RED often refers to studies conducted during historical times when atrazine had higher use rates, including non-agricultural uses, and when it was also applied in the fall to control quack-grass. Concentrations observed during these periods may not relate to current use practices and should be qualified as such if used in an exposure assessment.

The draft RED makes many conservative assumptions of exposure and duration. For example, the statement that “these high concentrations of atrazine may last for days” (p. 29), is unsupported by the data, because measurements were not frequent enough in the studies cited to determine the length of pulses of elevated concentrations.

The opinion expressed in the draft RED that the NAWQA sampling was not focused on periods of high atrazine concentrations is incorrect. NAWQA sampling was focused on the atrazine runoff period. Sixty-two percent of all NAWQA samples were taken in May, June, July, or August and 34% of samples were taken in May and June alone.

In the analysis of the Louisiana data set and elsewhere, the draft RED makes use of the distribution of annual maxima of analyses which greatly exaggerates the ecological risk. Consistent with higher tiers of risk assessment, other return frequencies would be more appropriate for flowing water or organisms with rapid recovery potential. Furthermore, although the mechanism of action of atrazine is described (p. 5), the most important point is missed - that is the reversibility of the inhibition of photosynthesis and the great potential for recovery from short exposures.

The draft RED cites the Lake Michigan Mass Balance study to suggest that atmospheric transport and deposition of atrazine may be ecologically important. Values of 24 to 29% are cited for atmospheric contribution to total loads entering Lake Michigan. However, the dominance of atmospheric deposition in Lake Michigan is due to the low level of other inputs. As a result of these low inputs, the concentrations of atrazine in Lake Michigan are toxicologically insignificant. Furthermore, the reported concentration of 50 µg/L for atrazine in rainfall in the Lake Michigan study (p. 10) is erroneous. The highest concentration observed in the Lake Michigan Mass Balance Study (2.8 µg/L) was associated with a sample that had insufficient sample volume and the calibration associated with the analysis did not meet QC acceptance criteria. Other than this value, the highest value observed was in the range of 0.4 µg/L.

The Chesapeake Bay data set that was used in the draft RED is not representative of the Bay as a whole and is old relative to currently available scientific citations. Furthermore the Agency has missed a number of important papers published since 1985. The Panel is aware of, and has evaluated, much more current literature and encourages the Agency to access this literature in moving from a preliminary to a final Atrazine RED document.

Statements in the draft RED imply that atrazine concentrations in rainfall are increasing, based on Minnesota data from 1991 to 1994 (p 71). Reliable environmental trends cannot be established on the basis of four years of data.

The assessment endpoints used in the draft RED (Tables 1-3) reflect the extremes of sensitivity to atrazine. Many of them are based on a few questionable microcosm and mesocosm results that are inconsistent with the much greater body of evidence from more than 30 studies reviewed by the Panel. Other assessment endpoints are based on the extremes of the toxicity distributions. For example, the assessment endpoint for non-vascular plants is taken as 1 µg/L, based on a 1976 report of decreased chlorophyll production by algae in non-standard 7-d tests. The Panel's analysis, based on standard algal toxicity endpoints, indicated that the 10^{th} centile of sensitivity among 45 species of freshwater and saltwater aquatic plants was 33 µg/L, consistent with the proposed EPA water quality criterion of 49 µg/L.

The summary of pond mesocosm effects on animals (p. 58) contains only one reference: Kettle et al. (1987). The inferred effects at 20 µg/L reported in this paper were anomalous results that cannot be confirmed from the published data and were discounted in subsequent publications by the same researchers. The summary of pond microcosm effects on plants (p. 59) cites only to Kettle et al. (1987) and Hoagland et al. (1993). The lowest exposure concentration in these two studies was 15 µg/L (Hoagland et al. 1993). Statements concerning effects at <0.1 to 10 µg/L are undocumented and are inconsistent with the microcosm and mesocosm results reviewed by the Panel.

The section on Interpretation of Results (pp. 20-21), describes the potential consequences of loss of rooted aquatic plants for other components of a pond ecosystem. However, microcosm and mesocosm studies indicate that loss of aquatic macrophytes occurs only at atrazine concentrations much greater than 50 ug/L. Furthermore, the Panel found no evidence of ecologically significant indirect effects at lower concentrations in the peer-reviewed literature.

The definitions of “estimated” and “likely” (p. 12) are confusing and not consistent with the use of these words in the scientific literature. Estimation implies the use of a model or an extrapolation process. This is not defined in the document. Likely could mean anything unless it is qualified. “Likely” should be defined as a probability and a full probabilistic assessment conducted in Tiers III and IV as discussed above.

The incident data from the Ecological Incident Information System (EIIS) is very poorly documented (p. 41). Only 61 incidents were reported, and in only one, was an analysis conducted which showed the presence of other pesticides that could have caused the observed mortality in fish. Fish mortality could result from runoff initiated inputs of organic matter and subsequent decreases in dissolved oxygen (DO) or from runoff of other more toxic substances. Fish kills were not observed in microcosms or in limnocorals treated with atrazine even at relatively great concentrations.

The analysis of possible interactions and synergism between atrazine and other substances is based on very few realistically conducted studies. It completely fails to consider the most important issue with mixture interactions - the likelihood of co-occurrence of the components.

In conclusion, the draft RED is limited to a Tier I/Tier II Risk Assessment. Because of the availability of more refined tools for risk assessment and a very comprehensive set of chemical and biological data for atrazine, the Agency should avail itself of the opportunity to incorporate higher Tiers of risk assessment such as has been done in the Panel report (Giddings et al. 2000). We would welcome input from EPA and opportunities for communication and would be happy to provide input and suggestions for refinement of the risk assessment.

Table 1. Summary of Tiered Probabilistic Risk Assessment for Atrazine

Tier	Effects Analysis	Exposure Analysis	Risk Characterization
1	Acute toxicity values (LC50s) for base set of species (daphnid, warmwater fish, coldwater fish, 4 algae, duckweed, mysid, marine fish) Chronic toxicity values (NOECs) for most sensitive invertebrate, fish, and plant in base set (daphnid, coldwater fish, duckweed)	GENeric EECs (GENEEC) for standard EPA pond; peak and 4-d, 21-d, 56-d time-weighted averages Single high-risk scenario Use patterns: corn, sorghum, sugarcane, turf, conifer, guava, macadamia nut, roadsides Environmental fate data: soil K_d, soil metabolism, aquatic metabolism (from base set)	Acute Hazard Quotients for each use pattern, based on peak EEC and LC50 for most sensitive plant and animal species in base data set Chronic Hazard Quotients for each use pattern, based on 21-d EEC and NOEC for most sensitive plant and animal species in base data set

Conclusions of Tier 1: Possible acute and chronic hazards to aquatic plants for all modeled use patterns. No acute hazard to animals, but possible chronic hazards for sugarcane and some minor uses.			
2	Acute and chronic toxicity concentration-effect relationships for most sensitive plant species (duckweed) and animal species (coldwater fish for acute toxicity, daphnid for chronic toxicity) in base set	Concentration distributions (PRZM/EXAMS) for ponds; annual and 30-d maxima 11 regions, up to 25 scenarios in each region, 36 years in each scenario Use patterns: corn, sorghum Environmental fate data: K_{oc}, aerobic and anaerobic soil metabolism, aerobic and anaerobic aquatic metabolism (from base set)	Joint Probability Curves relating percent mortality (animal) or percent growth inhibition (plant) for most sensitive plant and animal in base set, to area-weighted probability of occurrence in each region Joint Probability Curves relating percent reproduction inhibition for most sensitive animal in base set, to area-weighted probability of occurrence in each region
Conclusions of Tier 2: Low likelihood of acute or chronic effects on animals. Possible risk of acute or chronic effects on plants.			

3	Species sensitivity distributions for acute toxicity (LC50) to 45 plant species and 52 animal species Species sensitivity distributions for chronic toxicity (NOEC, LOEC, or chronic value) to 14 plant species and 17 animal species	Same as Tier 2 but based on full set of environmental fate data, plus: Concentration distributions (PRZM/EXAMS) for ponds in Florida sugarcane uses, 10 scenarios, 36 years in each scenario Concentration distributions (PRZM/RIVWQ) for flowing water, corn and sorghum uses, 6 regions, 1 or 3 scenarios in each region, 19 to 40 years in each scenario Typical as well as maximum use rates	Joint Probability Curves relating percent of species affected (plant and animal, acute and chronic) to area-weighted probability of occurrence in each region; ponds (corn, sorghum, and sugarcane uses) and streams (corn and sorghum only)
Conclusion of Tier 3: No risk to animals under all scenarios examined. Acute risk to plants is low except in streams in areas of greatest runoff potential. Possible chronic risk to plants in ponds.			

4	Mesocosm and microcosm results Toxicity data for atrazine metabolites and other triazines	Concentration distributions from surface water monitoring Event analysis: exposure duration and interval between exposure events Monte Carlo simulation of atrazine concentrations in ponds in Tennessee and Georgia Measured concentrations of atrazine metabolites and other triazines in surface waters	Joint Probability Curves relating percent of species affected to frequency of occurrence in field samples Joint Probability Curves relating percent of species affected to probability of occurrence in ponds (Monte Carlo simulations) Contribution of atrazine metabolites and other triazines to ambient toxicity
Conclusions of Tier 4: Monitoring data indicated that exposure models generally overestimated atrazine concentrations. Whole aquatic communities (in mesocosms and microcosms) are less sensitive to atrazine than the most sensitive species of plants and animals. Risk is extremely low for animals and is low for plants except in certain high-exposure situations (farm ponds and small streams in high-use, high-runoff areas). Effects in the high-exposure areas are likely to be transient and quick recovery of the ecological system is generally expected.			

References

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Solomon KR, Baker DB, Richards P, Dixon KR, Klaine SJ, La Point TW, Kendall RJ, Giddings JM, Giesy JP, Hall LWJ, Weisskopf C, Williams M. 1996. Ecological risk assessment of atrazine in North American surface waters. *Environmental Toxicology and Chemistry* 15:31-76.

Appendix 2

Summary of Atrazine Mitigation Measures Implemented Through Label Revisions

In the past 10 years there have been significant changes in the use pattern of atrazine. These can be segregated into three areas:

1. Removal of certain crops and high use rate non-crop application sites
2. Reduction in use rates on specific crops
3. Addition of labeling language under “Environmental Hazards” relating to set backs/buffers and mix/load pad requirements.

Specifically these can be partially itemized as follows:

1. Removal of certain crops and high use rate non-crop application sites.
    A. Deleted uses for rangeland, proso millet, and pineapples
    B. In 1990 reduced maximum rate for non-cropland and total vegetation control from 40 to 10 lbs. ai/A This use was subsequently deleted in 1992.

2. Reduction in use rates on specific crops
    A. Lowered maximum rate for corn and sorghum from 4 to 3 lbs./A, 1990
    B. Corn and Sorghum rate was further reduced in 1992 to a maximum of 2.5 lbs. ai/A/yr. if applied as a pre and post, or 2 lbs. ai/A/yr. if applied as a single pre or post application. This maximum also dependent on soil classification – whether highly erodible or not highly erodible
    C. Changed weed classifications to partial control due to rate reduction

3. Addition of labeling language under “Environmental Hazards”.
    A. In 1990;
        - Prohibited use in chemigation systems.
        - Addition of a 50-ft buffer for wellhead protection. No storage, mixing, loading or use within the buffer area.
        - Addition of recommendation to floor and dike bulk storage facilities for atrazine-containing products.
        - All atrazine-containing products designated Restricted Use Pesticides because of groundwater concerns.
    B. In 1992;
        - Expanded Restricted Use criteria to include surface water.
        - Addition of buffers: 1). 50 ft. mix/load for intermittent streams, rivers, lakes and reservoirs. 2). 66 ft application buffers from points of entry of surface water to perennial or intermittent streams and rivers. 200 ft. for lakes and reservoirs. 3). For highly erodible land, the 66 ft. buffer must be planted to the crop or seeded with grass or other suitable crop.
        -

Addition of statement that: if more restrictive local use conditions were stipulated by state or local requirements, the most restrictive measures must be followed. Allows the use of localized Best Management Plans for a more flexible program, where needed.

C. In 1996: - Added Tile-Terraced Fields Containing Standpipes: To ensure protection of surface water from runoff through standpipes with tile-outlets in terraced fields, one of the following may be used.
   - Do not apply within 66 ft. of standpipes in the tile-outletted terraced fields.
   - Apply to the entire tile-outletted terraced field and immediately incorporate it to a depth of 2-3 inches in the entire tile-outletted terraced field.
   - Apply to the entire tile-outletted terraced field under a no-till practice only when a high crop residue management practice is practiced. High crop residue management practice is descried as a crop management practice where little or no crop residue is removed from the field during and after crop harvest.

These changes have led to a lowering of application rates on high acreage crops, eliminating high rate use on certain crops and sites, and restricting use from vulnerable areas of fields near water.

Appendix 3

Aquatic Ecological Risk Assessment of Atrazine – A Tiered Probabilistic Approach. A Report of an Expert Panel. Giddings, et al. 200

[*Appendix 3 removed due to Confidential Business Information]*

Appendix 4

List of References cited by the EPA for which Novartis is requesting a copy

Page 10

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- PRZM input files from EFED
  -
- EPA ecological incident reports
  -
- An atrazine value in water of 635 ppb cited by EPA (Page 25), but no reference is cited
  -
- Carbamate interaction with atrazine report

Page 3: Reference to 7-day fetal resorption cited by EPA. Syngenta requests that EPA clarify the study from which this statement is taken.

Page 43, Paragraph 2: EPA states that it did not have access to the raw data necessary to evaluate some of the studies in the published literature.

List which studies were evaluated in raw data.

List which studies were not evaluated (i.e., raw data not available).

Page 53: BEAD's Qualitative Usage Analysis (dated May 10, 1999) and the process used by EPA to weight the different usage databases for this assessment.

Page 70: Copy of e-mails from Russell Kries (USEPA, Great Lakes National Program Office, Region 5, 11/7/2000 and 11/9/2000.

Appendix 5

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